

**ADMINISTRATIVE ORDER NO. 58-20-26**  
**of the**  
**Executive Director of the Public Works Department**

**APPROVING THE 2020 WASTEWATER MASTER PLAN.**

**The Executive Director of the Public Works Department finds that:**

**A.** Under the provisions of Chapter IV, Section 16 of the Eugene Charter of 2002, the City Manager is designated as the administrative head of the City, and is specifically authorized to appoint and remove all employees (except as otherwise provided in the Charter), and to enforce all ordinances of the City.

**B.** Pursuant to that authority, I have been designated as Executive Director of the City's Public Works Department. My appointment has most recently been affirmed by the City Manager's Administrative Order No. 21-20-02. In such capacity, I have the responsibility for supervision of the Public Works Department and its employees.

**C.** The 2020 Wastewater Master Plan (Master Plan) has been developed to replace the 1992 Urban Sanitary Sewer Master Plan. The Master Plan documents the feasibility of providing wastewater service to the study area and provides guidance for design and rehabilitation of an effective wastewater system throughout the study area.

**D.** The Master Plan is to be used by City staff and private engineers for background/contextual information, for estimating wastewater flow rates for proposed developments without specific upstream development plans, and for outlining a wastewater rehabilitation program. The Master Plan will not be used in a manner that regulates conduct or activities of the public and is not a land use plan or a systems development charge capital improvement plan.

**E.** The Master Plan:

- (1) Identifies the major wastewater basins and major sub-basin delineations within the study area;
- (2) Provides one solution to ensure wastewater service throughout the study area;
- (3) Provides design guidance for future developments upstream of specific development plans;
- (4) Describes a long-term (20-year planning period) capital improvement program for major systems expansion within the study area; and
- (5) Outlines a program to address wastewater rehabilitation of the existing system.

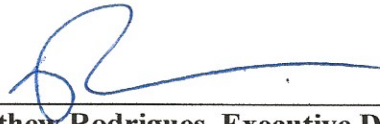
**F.** The design criteria for wastewater system expansion and improvements contained in the Master Plan, and other specific information about design and analysis methods serve as guidance to the City and the public and are neither requirements nor prohibited conduct.

**NOW, THEREFORE**, based on the above findings, which are hereby adopted, I order that:

1. The 2020 Wastewater Master Plan (Master Plan) attached to this Order as Exhibit A is hereby approved and shall be utilized by staff in the Public Works Department in the evaluation of development proposals. The Master Plan shall not be used as approval criteria.

2. The 1992 Urban Sanitary Sewer Master Plan is rescinded.

Dated this 17<sup>th</sup> day of August, 2020.

A handwritten signature in blue ink, consisting of a stylized 'M' followed by a long horizontal stroke.

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**Matthew Rodrigues, Executive Director (AIC)**  
**Public Works Department**

## Table of Contents

Chapter 1: Introduction and Summary .....	1
MASTER PLAN PURPOSE .....	1
GENERAL .....	1
SUMMARY OF CONCLUSIONS .....	2
Chapter 2 - Study Area and Land Use .....	4
PURPOSE .....	4
BACKGROUND .....	4
GENERAL .....	4
MAJOR SYSTEM BASINS AND SUB-BASINS.....	5
DEVELOPMENT PLANNING .....	5
PRESENT AND FUTURE LAND USES.....	5
Chapter 3 - Existing Wastewater Systems .....	8
PURPOSE .....	8
HISTORICAL BACKGROUND .....	8
MAJOR BASINS .....	9
Highway 99 Industrial Area, including the Airport (SI & AI).....	9
River Road/Santa Clara (RR & SC) .....	10
Willakenzie North, Willakenzie South and Willamette River (WN, WS & WR).....	10
Bethel (BN) .....	10
South West (SW) .....	10
Downtown (DW, DC, DF & DA) .....	11
Laurel Hill (LH).....	11
SYSTEM CHARACTERISTICS AND VALUATION .....	11
EXISTING WASTEWATER PUMP AND LIFT STATIONS.....	13
Highway 99 Industrial Area and Airport Stations .....	14
River Road/Santa Clara Stations .....	14
Willakenzie Stations .....	15
Bethel Stations .....	15
Central Eugene Stations.....	15
SEISMIC ASSESSMENT OF THE WASTEWATER COLLECTION SYSTEM .....	17
Chapter 4 - Design Criteria.....	28



PURPOSE .....	28
LAND USE INFORMATION .....	28
BASE WASTEWATER FLOWS .....	29
Base Wastewater Flow Rates for Residential Areas .....	29
Base Wastewater Flow Rates for Commercial and Industrial Areas.....	30
Campus Industrial .....	30
PEAK FLOW FACTOR.....	31
Design Depth of Flow .....	31
INFILTRATION/INFLOW .....	31
General.....	31
New Systems.....	32
Existing Systems .....	32
SUMMARY OF PROPOSED DESIGN CRITERIA FOR NEW SYSTEMS .....	32
Average Dry-Weather Flow.....	32
Peak Flow Factor (PFF).....	33
Infiltration/Inflow - New Development Areas .....	33
Chapter 5 - Rehabilitation of Existing Wastewater Systems.....	35
PURPOSE .....	35
GENERAL .....	35
WASTEWATER SYSTEM REHABILITATION PROGRAM .....	36
Methods for Problem Identification .....	36
Methods for Correction and Quality Control.....	37
Wastewater Model Development .....	37
Rehabilitation Planning Process.....	38
Finance Planning .....	39
REHABILITATION OF PRIVATE SERVICE LATERALS .....	39
REHABILITATION COSTS.....	40
Mainline Rehabilitation Unit Costs .....	40
Public Lateral Rehabilitation Costs.....	41
Manhole Rehabilitation Costs.....	41
Long-Range Rehabilitation Planning .....	41
ADDITIONAL INFORMATION .....	42
Chapter 6 - Basis of Cost Estimates.....	46

PURPOSE .....	46
GENERAL .....	46
WASTEWATER CONSTRUCTION COSTS.....	46
SERVICE LATERALS .....	48
WASTEWATER PUMP STATIONS.....	48
WASTEWATER PRESSURE LINES.....	50
ADDITIONAL INFORMATION .....	50
Chapter 7 - Major Collection System Expansion.....	51
PURPOSE .....	51
GENERAL COST INFORMATION.....	51
PRELIMINARY DESIGN AND COST ESTIMATED BY AREA .....	52
South West Eugene (SW) .....	53
Highway 99 Industrial Area (SI).....	53
Willakenzie Area (WN).....	53
Clear Lake Road (SI/BN) .....	54
Glossary and Key to Abbreviations .....	68
Appendices.....	70

# Chapter 1: Introduction and Summary

## MASTER PLAN PURPOSE

The Wastewater Master Plan (master plan) was initiated by the City Engineer to organize a wide variety of information about the City of Eugene wastewater collection system and to update the 1992 Urban Sanitary Sewer Master Plan (USSMP). The plan's scope includes all public portions of the collection system owned and maintained by the City of Eugene, including pump stations. It excludes facilities owned by the Metropolitan Wastewater Management Commission as well as facilities on private property. The planning period for this document is 20 years. The purpose of the master plan is to:

- Provide historical information about the development of the existing system.
- Identify general problems and rehabilitation needs of the existing system.
- Provide design criteria to be used for future system expansion.
- Identify future needs and estimated costs to extend major system improvements to unserved areas within the urban growth boundary.

The master plan is intended to be useful to several groups:

- City staff, to ensure consistency in various wastewater-related analyses;
- Policy makers, to provide background and guidance in the consideration of wastewater-related plans and policies; and
- Developers and other private interests, to aid them in their understanding of the various requirements related to the expansion and preservation of Eugene's wastewater system.

Through the efforts outlined in this master plan, the City will continue to build and maintain a wastewater collection system that meets several key objectives:

- Protect the public health and our local water resources
- Meet the NPDES permit requirement by eliminating sanitary sewer overflows
- Build new improvements with an expected life of more than 100 years
- Size improvements to ensure upstream future developments have capacity
- Ensure improvements are water-tight and reduce infiltration and inflow
- Minimize risk and increase seismic resiliency

## GENERAL

Carefully planned, well-engineered, regularly maintained wastewater collection and treatment systems protect public health and support economic growth. For thousands of years, water has been the primary vehicle for conducting away community wastes. The collection and disposal of sewage has evolved over the past several centuries to include elaborate underground piped networks and complex treatment facilities. The basic layout for a modern wastewater collection system includes small-diameter, shallow pipes that connect homes and businesses to the public system. These lateral pipes connect to larger, deeper pipes that typically run under roadways and ultimately discharge to a treatment plant.

As detailed in Chapter 3, wastewater system construction began in central Eugene between 1900 and 1910. The wastewater collection system expanded very slowly prior to 1945. The initial system was a combined system that collected both stormwater and wastewater flows.

The combined wastewater system discharged untreated wastes to the Willamette River until about 1950, when the first Eugene primary wastewater treatment plant was constructed on River Avenue. Between 1960 and 1970, separate stormwater and wastewater systems were constructed, and most of the direct stormwater inflow from street and alley drainage was removed from the wastewater system.

In 1977, Eugene, Springfield, and Lane County jointly formed the Metropolitan Wastewater Management Commission (MWMC) to develop a regional wastewater treatment system for the Eugene-Springfield Metropolitan Service Area. The new plant on River Avenue was completed in 1984 and was designed to process a peak wet weather flow of 175 MGD. The regional system, which comprises the system components that serve both Eugene and Springfield, also includes the larger pipes and pump stations in the wastewater collection system as well as facilities to treat solid wastes (biosolids) and irrigate effluent for agricultural purposes.

Between 1980 and 1999 major collection system expansion occurred. Approximately 32 percent of the local wastewater system was built during this period. In 1992, the Urban Sanitary Sewer Master Plan (USSMP) was adopted to inventory the existing system and provide data and analysis for planning, designing, rehabilitating and managing Eugene's wastewater collection system.

As of 2019, Eugene owned and operated 717 miles of wastewater collection lines. The local system also includes approximately 20,000 manholes and 27 local pump stations.

## **SUMMARY OF CONCLUSIONS**

While the basic layout for a wastewater collection system is simple enough, the complexities of the system arise almost immediately. How large should the pipes be? How deep? Can the system be expanded to accommodate new development? What if portions of the system can't flow by gravity to the outfall? What is the condition of the collection system, and how long will any particular pipe last before it needs to be rehabilitated? The Wastewater Master Plan strives to answer the question, "what should be built and when?"

For example, if a particular wastewater pipe can no longer convey the volume of wastewater demanded of it, it must be replaced with a larger diameter pipe, or a second parallel pipe must be built. If that larger pipe is sized to handle only current flows it will need to be replaced a second time when additional development occurs. A more cost-effective solution is to replace the pipe once using a larger pipe that may be underutilized in the short term but is adequate for planned developments within the planning horizon.

In general, the master plan focuses on providing objective data that can be further analyzed and inform decision making. The data also support several conclusions, which are summarized below:

- Chapter 2 indicates that the City anticipates an increase in population, commercial land use, and industrial land use in every major wastewater basin.
- As stated in Chapter 3, effective 2017 the City has taken ownership and maintenance responsibilities for all wastewater lines within the public rights of way, which includes more than 60,000 lateral lines.



- Chapter 3 also concludes that the City of Eugene has maintained excellent GIS information about the wastewater system, allowing a high level of planning and certainty in the system characteristics and function.
- Seismic studies indicate that Eugene’s wastewater system should perform reasonably well in the event of an earthquake. Most of the city’s pump stations are located in non- to low-liquification zones, and less than 1 percent of the gravity wastewater line segments are expected to experience some level of damage. Adherence to seismic standards for pump station construction and continued cured-in-place pipe rehabilitation will further improve the structural integrity of the system.
- Chapter 4 notes that sizing a wastewater system without specific development plans or a unified ownership or shared development strategy in the upper reaches of the basin is challenging. The methodology outlined in this chapter is typical of many municipalities and has been successful in the design of much of the Eugene system. Utilizing this methodology when preparing a wastewater study should minimize the need for capacity expansion under normal development conditions.
- Private service laterals and private systems and their contribution of inflow and infiltration to the local and regional system are likely to be a growing issue, as discussed in Chapter 5. Further analysis of the problem is needed, and a long-term strategy should be implemented to ensure that system capacity is preserved and regulatory goals eliminating sanitary sewer overflows are met.
- As detailed in Chapter 5, nearly 29 percent of Eugene’s wastewater collection system is at least 50 years old and has not been rehabilitated. Studies indicate that 50 years may approach the design life of concrete pipe materials, particularly those installed before advanced gasket technology was available. In addition, the systemwide needs due to future urban development must be considered.
- Chapter 5 also recognizes that a significantly increased funding level for rehabilitation over the next 20 years is critical to catch up with the demand of rehabilitating the existing concrete pipe inventory. As of 2019, the total estimated cost to rehabilitate 202 miles of the oldest parts of Eugene’s system exceeded \$185 million.

## Chapter 2 - Study Area and Land Use

### PURPOSE

The purpose of this chapter is to establish the planning framework for the wastewater system analysis and the land-use and population basis for system calculations.

### BACKGROUND

In the 1992 Urban Sanitary Sewer Master Plan (USSMP), the study area included areas beyond the Urban Growth Boundary (UGB) that were identified in the 1987 Eugene-Springfield Metropolitan Area General Plan boundary as urban reserves. However, in June 2001 the Lane Council of Governments produced an Urban Reserve Analysis and Alternatives Report. That report concluded that it was not appropriate to designate urban reserves without extensive further analysis. This conclusion was approved by all three Metro jurisdictions.

Two major pump stations, Glenwood and Barger, were built in the late 1990s and designed to include expected development within the 1987 urban reserve areas. Since that development never happened, both pump stations are currently underutilized. However, the Barger station has the capacity to provide 100 percent back-up for the Terry Street pump station, and the Glenwood station has sufficient capacity for Springfield's redevelopment of Glenwood.

As of 2020, new urban reserves are under consideration. Nevertheless, no urban reserve areas will be included in the study area for this document. The planning period and scope of urban reserves planning render these areas inappropriate to be used for wastewater design.

### GENERAL

The study area for this plan includes all areas for which the City of Eugene is expected to construct and/or maintain the wastewater collection system. The study area is based on Eugene's UGB at the end of 2019 and the lands included as part of the Eugene Airport, as shown on Map 2-A.

Based on the study area of this plan, the larger undeveloped areas that will require major wastewater system expansion are:

- North Willakenzie
- North Highway 99N Industrial area
- Willow Creek area
- South Bailey Hill
- West 11<sup>th</sup>/Crow Road
- Clear Lake Road

Each of these areas is described in more detail in Chapter 7.

There are other areas that have considerable growth potential but appear to have minor financial impact on the City's capital wastewater program. In these areas, wastewater service can be extended from existing trunk systems with 8-inch pipes. Under City Code 7.175(6), the cost of these extensions is paid by the owners of the benefitted parcels. These areas include:

- Laurel Hill
- South Amazon
- Royal Node

## **MAJOR SYSTEM BASINS AND SUB-BASINS**

To analyze flow in the wastewater collection system, the study area was divided into major system basins and sub-basins as shown in Map 2-A. These basins and sub-basins were initially based on the network system developed in the 1978 Sewer System Evaluation Survey (SSES) report by CH2M-Hill and the 1992 USSMP. Minor basin boundary modifications have been made to those basins as published to reflect actual construction, elimination of the urban reserve and increased topographic mapping capabilities. In addition, the Bethel South major basin was renamed South West, and the Bethel North basin was renamed Bethel.

## **DEVELOPMENT PLANNING**

Development within Eugene and Springfield is guided by the Eugene-Springfield Metropolitan Area General Plan (Metro Plan). The Metro Plan, which serves as the regional comprehensive land use plan, promotes compact growth through the use of an urban growth boundary. Growth occurs by development of vacant and underutilized lands, as well as redevelopment inside the urban growth boundary. Development within Eugene is also guided by the Envision Eugene Comprehensive Plan, adopted in 2017 as Eugene's city-specific land-use plan. The Envision Eugene Comprehensive Plan guides future growth within Eugene's UGB.

More detailed land-use planning is provided in neighborhood refinement plans, special area studies, and the Eugene-Springfield Public Facilities and Services Plan. This level of detailed planning allows public utilities, services, and facilities to be designed and constructed in an orderly and efficient manner.

## **PRESENT AND FUTURE LAND USES**

The Envision Eugene Comprehensive Plan used a geographic model, along with input from technical experts, to create the inventory of the City's land supply. The City compared projected land-use needs to the capacity available in the City's buildable land supply as further described in the Envision Eugene Employment Land Supply Study. Based on this analysis, the UGB was expanded in 2017 to meet 2012-2032 land-use needs. Table 2-1 uses similar methods as the Envision Eugene Comprehensive Plan to illustrate how development is expected to affect each wastewater basin.

For residential development, the City receives a certified city-wide population estimate. The City estimated 2017 basin populations using methods similar to the Comprehensive Plan's method (2.24 persons per household per the 2010 U.S. Census multiplied by the number of residential address points in the Regional Land and Information Database). These results are shown in Table 2-1.

The 2032 basin population estimates in Table 2-1 equal the 2017 population plus anticipated growth through 2032. Housing growth was estimated using several methods. On vacant and partially vacant areas the method was similar to the Envision Eugene Comprehensive Plan, Residential Land Supply Study housing capacity estimates for 2012-2032. Also taken into account was a baseline amount of housing redevelopment. Finally, consideration was given to political measures that increase legal residential land density. Every new housing unit was assumed to add 2.24 persons to the basin.

The 2012 land areas in Table 2-1 were derived from developed land data in the Envision Eugene Comprehensive Plan, Employment Land Supply Study. The 2032 land areas equal the 2012 land areas plus 20 years of anticipated development. The additional developed land is estimated from two sources: commercial and industrial development occurring on vacant and partially vacant land and conversion of non-employment land to employment land. Therefore, some of the additional 2032 development is on land already identified as developed in 2012.

*Table 2-1: Population Estimate and Land Use Projections for Eugene Wastewater Basins*

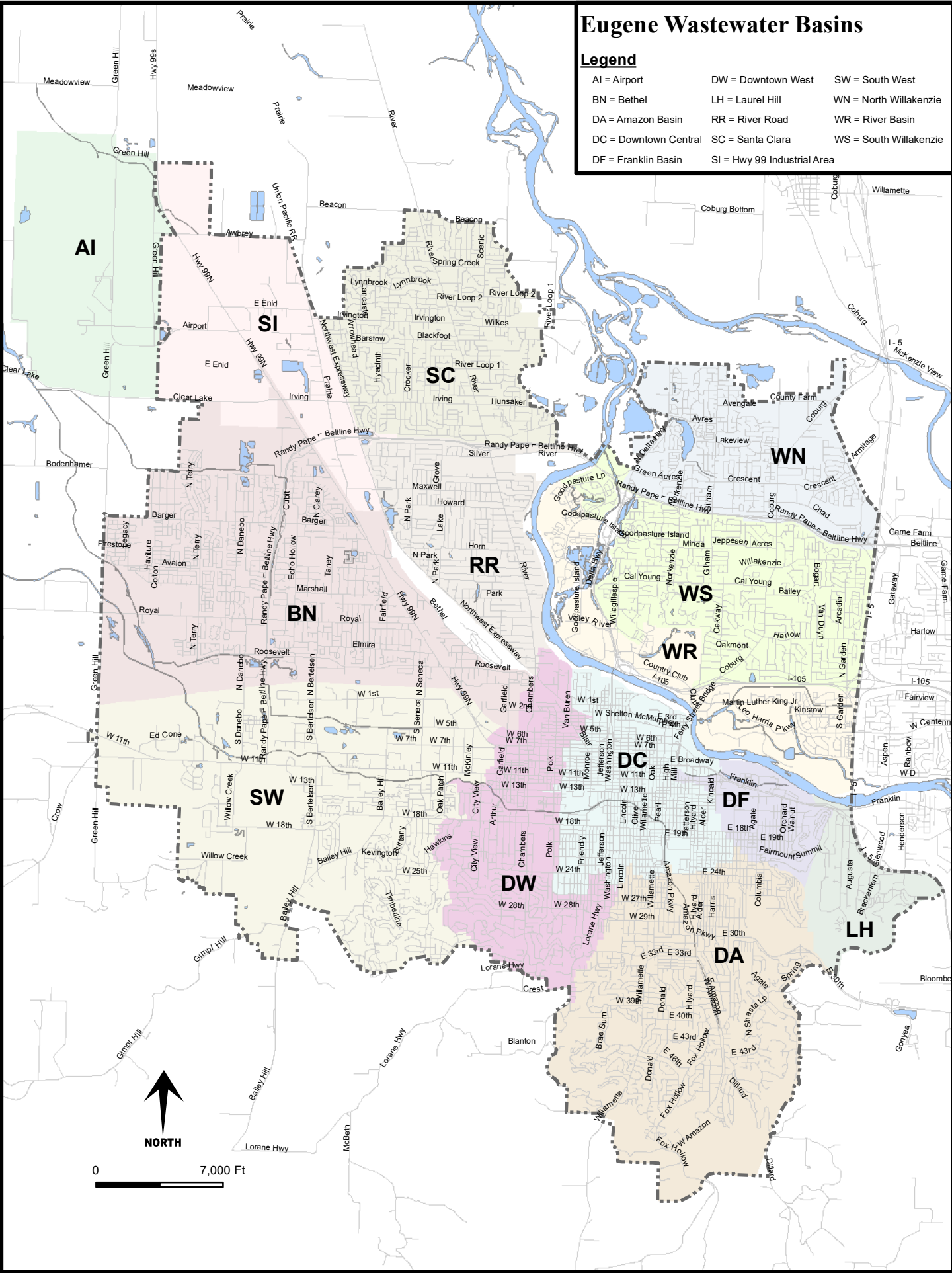
<b>Major Basins</b>	<b>Population</b>		<b>Commercial Land Area (Acres)</b>		<b>Industrial Land Area (Acres)</b>	
	<b>2017</b>	<b>2032</b>	<b>2012</b>	<b>2032</b>	<b>2012</b>	<b>2032</b>
Highway 99 Industrial Area, including Airport (SI, AI)	338	403			729	836
River Road/Santa Clara (RR, SC)	30,179	35,209	128	146		
Willakenzie (WN, WR, WS)	41,541	50,362	456	485	96	148
Bethel (BN)	28,325	31,812	147	160	411	462
South West (SW)	12,905	21,190	148	175	817	1,044
Downtown (DA, DC, DF, DW)	70,826	81,828	345	350	82	84
Laurel Hill (LH)	1,622	3,819	5	16		
Outside defined basins				350		640
<b>Totals</b>	<b>185,736</b>	<b>224,623</b>	<b>1,229</b>	<b>1,682</b>	<b>2,135</b>	<b>3,214</b>



# Eugene Wastewater Basins

## Legend

- |                       |                             |                        |
|-----------------------|-----------------------------|------------------------|
| AI = Airport          | DW = Downtown West          | SW = South West        |
| BN = Bethel           | LH = Laurel Hill            | WN = North Willakenzie |
| DA = Amazon Basin     | RR = River Road             | WR = River Basin       |
| DC = Downtown Central | SC = Santa Clara            | WS = South Willakenzie |
| DF = Franklin Basin   | SI = Hwy 99 Industrial Area |                        |



## Chapter 3 - Existing Wastewater Systems

### PURPOSE

The purpose of this chapter is to provide detailed information about Eugene's seven major wastewater basins and evaluate the wastewater system infrastructure, including pipe and pump stations, to provide adequate service to meet current and future needs. The main sections in this chapter discuss historical background, major basins, system characteristics, and existing pump and lift stations.

### HISTORICAL BACKGROUND

Wastewater construction began in central Eugene between 1900 and 1910. The wastewater collection system expanded very slowly prior to 1945. The initial system was a combined storm and wastewater system.

After World War II, the Eugene system expanded rapidly to provide service to development in newly annexed areas. Development was also rapid in areas outside the city (Willakenzie, Bethel-Danebo, River Road, and Santa Clara) where wastewater service was initially provided by individual septic tanks.

The combined wastewater system discharged untreated wastes to the Willamette River until about 1950 when the first Eugene primary wastewater treatment plant was constructed at the present River Avenue site. Major treatment plant improvements were made in 1959, 1965, and 1970 to increase capacity and upgrade from primary to secondary treatment.

A major wastewater rehabilitation program was also accomplished between 1960 and 1970. The combined storm and wastewater system in the older central Eugene area caused serious overloads in the collection system and also at the treatment plant. Separate wastewater pipes were constructed and most of the direct stormwater inflow from street and alley drainage was removed from the wastewater system. Construction costs for separation of the combined system totaled about \$6 million. This would be equivalent to about \$70 million in 2019 dollars.

In 1977, Eugene, Springfield, and Lane County jointly formed the Metropolitan Wastewater Management Commission (MWMC) to develop a regional wastewater treatment system for the Eugene-Springfield Metropolitan Service Area. The Eugene treatment plant on River Avenue was enlarged to accommodate the new regional wastewater flows. The new plant was completed in 1984 and serves the entire Eugene-Springfield area. At that time, it was designed to process a peak wet weather flow of 175 MGD.

Between 1980 and 1999 major collection system expansion occurred. Approximately 32 percent of the current system was built in that time frame. Interceptors, pump stations, and pressure lines were constructed to serve the River Road, Santa Clara, and west Eugene/Willow Creek areas.

In the late 1990s, a wastewater model for the Eugene-Springfield service area was developed by CH2MHill. The primary focus of that model was to support the regional wastewater treatment plant improvements. That model, and subsequent updates, focused on large-diameter pipes, typically 12 inches in diameter and greater. In 2014, the City of Eugene's staff began working on a Eugene model. All pipes with diameters 10 inches and larger and all connected pump stations were included in the model. In 2016 the model was fully calibrated for both wet weather and dry weather flows and work began to

expand the model to include 8-inch diameter pipes, starting in areas where the focus is to reduce Infiltration/Inflow.

In 2004 a comprehensive update to the 1977 regional wastewater treatment plan was completed. The 2004 plan included an evaluation of the regional wastewater treatment facilities, including Eugene-Springfield Water Pollution Control Facility (E-S WPCF), major pump stations and interceptors, the Biosolids Management Facility, the Biocycle Farm, and the Seasonal Industrial Waste Facility. The intent of this MWMC Facilities Plan was to identify facility enhancements and expansions necessary to serve the community's wastewater needs through 2025. The plan identified improvements necessary to increase the capacity from 175 MGD to 277 MGD to serve a 2025 MWMC metro population of 297,585.

Some of the improvements of the 13-phase, \$144 million project included significant upgrades to the existing facilities and installation of new pretreatment grit removal, digesters, additional clarifiers and a new tertiary filtration system and high-rate disinfection facilities. By 2016, the majority of regional capital projects identified in the 2004 MWMC Facilities Plan and the 2014 MWMC Partial Facilities Plan Update dealing with wastewater capacity and treatment needs through 2025 had been completed.

In 2017, the City simplified the jurisdictional boundary of private versus public wastewater systems. Prior to that time, the portion of the service lateral to a business or residence was public within the right of way if it was built with the mainline and considered private if it was built after the mainline. This distinction was difficult to track for both the City and the public. Effective 2017 the City has taken ownership and maintenance responsibilities for all wastewater lines within the public rights of way, which includes more than 60,000 lateral lines.

## **MAJOR BASINS**

The 1992 USSMP divided the Eugene service area into 14 major basins (Map 3-A shows the basins and major system components) and 144 sub-basins, shown in basin flow diagrams (see Map 3-B West and Map 3-C East). Several of the major basins have a common outfall and similar characteristics and, therefore, are grouped together for the purpose of this plan. The seven groups are:

- Highway 99 Industrial area, including the Airport
- River Road/Santa Clara
- Willakenzie
- Bethel
- South West
- Downtown
- Laurel Hill

Each group of major basins is described as follows:

### ***Highway 99 Industrial Area, including the Airport (SI & AI)***

The Highway 99 Industrial Area (see Map 3-D) is the area between State Highway 99 and Northwest Expressway and includes seven sub-basins. There are currently 8 miles of wastewater lines in this basin, all of which have been constructed since 1985.

The Highway 99 Industrial Area has a significant amount of undeveloped or underdeveloped land. The 1992 USSMP required two new pump stations to serve this basin, but they have not yet been built, and are still necessary.

As detailed in Chapter 7, the 2017 Urban Growth Boundary expansion will be mostly served by the SI basin. Also, the existing Enid Pump Station is expected to be relocated and upsized to also serve development in that area.

The Airport has been divided into three sub-basins corresponding with the three pump stations that serve this area. Planned wastewater expansion in this basin is minimal.

#### ***River Road/Santa Clara (RR & SC)***

The River Road basin (see Map 3-E) includes nine sub-basins, all south of the Beltline Highway between the Willamette River and Northwest Expressway. With the exception of the West Bank interceptor built in 1951, the 48 miles of wastewater lines in this basin were built since 1971. Of those 48 miles, 37 miles were built since 1990.

The Santa Clara basin includes 10 sub-basins, all north of Beltline and east of Northwest Expressway. The majority of the 82-mile system has been built since 1980.

With the exception of the eastern fringe, and some limited in-fill, the properties in the River Road and Santa Clara basins are fully served.

#### ***Willakenzie North, Willakenzie South and Willamette River (WN, WS & WR)***

The Willakenzie group (see Map 3-F) includes everything north of the Willamette River and is divided into three major basins (North, South and River) and 21 sub-basins.

The first wastewater line was built in 1962 in the Willakenzie area. Approximately 33 percent of the existing system was built in the 1960s. Currently, there are 127 miles of wastewater lines and five local pump stations. The entire basin drains to the Willakenzie pump station, which is a regional pump station that also receives all of the flow from the city of Springfield through the East Bank interceptor.

There are still a number of undeveloped parcels in the northern part of the basin.

#### ***Bethel (BN)***

The Bethel basin (see Map 3-G) includes everything west of Bethel Drive and north of the Southern Pacific railroad tracks. There are 19 sub-basins and 102 miles of wastewater pipe, with the first lines built in 1964. The Bethel basin has three large pump stations: West Irwin, Barger, and Terry. All three stations pump into dual force mains that run along Beltline Highway to the treatment plant. The Barger and Terry stations receive flow from the South West basin.

Since the 1992 plan, a significant portion of the basin has been designated as wetlands or has been converted to wetlands and is no longer available for development. With the exception of the Royal Node area (west of Terry Street, north and south of Royal Avenue), the basin is fully served.

#### ***South West (SW)***

The South West basin (see Map 3-G), formerly known as Bethel South, includes the area south of the Southern Pacific railroad tracks and west of the Downtown West basin. There are 14 sub-basins. There



are 72 miles of wastewater pipe, about half of which were built prior to 1980, with the first segments built in the early 1950s.

Since the 1992 plan, a significant portion of the basin was either determined to be wetlands, or converted to wetlands, and is no longer available for development. There is still a large amount of undeveloped land in the southern part of the basin, primarily along Bailey Hill Road, Willow Creek Road and West 11<sup>th</sup> Avenue. There currently are no pump or lift stations within the basin, but to serve the Bailey Hill area, a pump station will need to be built. The entire South West basin drains to either the Terry or Barger pump stations in the Bethel basin.

#### ***Downtown (DW, DC, DF & DA)***

The Downtown group (see Map 3-H and Map 3-I) includes four major basins (West, Central, Amazon, and Franklin) which are further divided into 61 sub-basins. The area extends from City View on the west, the UGB on the south, Fairmount Boulevard on the east, and the Willamette River on the north.

The Downtown group is served by a network of about 261 miles of lateral, trunk, and interceptor wastewater lines that carry wastewater downstream to the Fillmore lift station near Polk Street next to the south bank of the Willamette River.

The total flow is then routed through a 72-inch gravity interceptor on the west side of the river to the regional wastewater treatment plant. The 72-inch West Bank interceptor was constructed in 1951, has a 2007 modeled design capacity of 117 MGD, which will be adequate if infiltration is minimized in new system construction and infiltration/inflow is reduced by rehabilitation of the existing system.

Approximately 182 miles of pipe in this basin group was more than 50 years old in 2019. Significant rehabilitation projects have been constructed since 1995 to address existing infiltration/inflow (I/I).

With the exception of the southernmost parts of the Amazon basin, the Downtown group is fully served by wastewater infrastructure.

#### ***Laurel Hill (LH)***

The Laurel Hill basin (see Map 3-I) is the area east of Floral Hill Drive. The first segments of wastewater pipe were built in the early 1950s. Approximately nine miles were built prior to 1982, with no construction for the next 18 years. Since 2000, three additional miles of pipe have been built.

Prior to 1994, flow from this basin went by gravity down Judkins Road and Franklin Boulevard to Judkins Point lift station. In 1994, the Glenwood regional pump station was completed, and the entire basin has been redirected to that station.

Approximately 60 percent of the basin is undeveloped. All future development flows will continue to be directed to the Glenwood pump station.

### **SYSTEM CHARACTERISTICS AND VALUATION**

The total length of the wastewater collection system was about 717 miles as of 2019. Also, there are 27 local pump stations and two regional pump stations located in Eugene and about 11 miles of pressure lines within the system. In general, modern PVC pipe was not introduced until the early 1980s. Most pipe installed prior to that time is concrete, clay, or truss pipe. Tables 3-1 and 3-2 indicate the years of construction. Map 3-J shows the system by original year of construction.

<i>Table 3-1: Wastewater Inventory by Year Constructed – Gravity System</i>		
<b><i>Year Constructed</i></b>	<b><i>Percent of System</i></b>	<b><i>Length of Pipe (feet)</i></b>
1912-1919	1%	437,680
1920-1929	2%	90,960
1930-1939	1%	23,800
1940-1949	4%	141,330
1950-1959	9%	336,790
1960-1969	25%	925,180
1970-1979	17%	617,240
1980-1989	9%	337,190
1990-1999	23%	850,290
2000-2009	7%	273,090
2010-2019	2%	77,400
<b>Total</b>		<b>3,716,940</b>

<i>Table 3-2: Wastewater Inventory by Year Constructed – Pressure System</i>		
<b><i>Year Constructed</i></b>	<b><i>Percent of System</i></b>	<b><i>Length of Pipe (feet)</i></b>
1950-1959	0.4%	266
1960-1969	19%	11,120
1970-1979	2%	1,126
1980-1989	35%	21,257
1990-1999	34%	20,444
2000-2009	9%	5,293
2010-2019	0%	22
<b>Total</b>		<b>59,665</b>

The estimated replacement value of the gravity collection system, including 25% for engineering, based on 2019 construction costs, is \$855 million, as shown in Table 3-3.

Table 3-3: Existing Wastewater System Estimated Replacement Value – Gravity System

Pipe Diameter (inches)	Average Trench Depth (feet)	Systems Length (feet * 1000)	Estimated Construction Cost (per foot) <sup>1</sup>	Total Unit Cost <sup>2</sup>	Reconstruction Total Cost (in millions)
4	5	5.89	\$111.18	\$138.97	\$0.82
6	7	270.57	\$153.89	\$192.36	\$52.05
8	8	2,714.01	\$156.15	\$195.18	\$529.73
10	10	173.16	\$158.20	\$197.75	\$34.24
12	11	127.33	\$202.01	\$252.52	\$32.15
14	8	2.51	\$170.45	\$213.06	\$0.53
15	12	77.45	\$211.94	\$264.92	\$20.52
16	10	1.61	\$212.10	\$265.12	\$0.43
18	13	91.49	\$261.81	\$327.26	\$29.94
21	14	50.34	\$280.86	\$351.08	\$17.67
22	8	1.23	\$260.49	\$325.61	\$0.40
24	12	29.19	\$292.54	\$365.68	\$10.67
27	14	16.77	\$339.40	\$424.25	\$7.12
30	15	43.78	\$387.83	\$484.78	\$21.22
36	16	45.92	\$502.32	\$627.90	\$28.83
42	17	8.66	\$547.79	\$684.74	\$5.93
48	20	27.87	\$631.83	\$789.78	\$22.01
54	20	11.85	\$753.24	\$941.54	\$11.16
60	18	7.42	\$875.99	\$1,094.99	\$8.13
66	17	7.28	\$935.83	\$1,169.79	\$8.51
72	14	11.35	\$888.64	\$1,110.80	\$12.61
<b>Total</b>		<b>3,725.67</b>			<b>\$854.68</b> <sup>3</sup>

<sup>1</sup> Estimated construction costs are from Table 6-1 of this report for construction in developed areas, and include 6 inches of asphalt concrete pavement (ACP) surfacing

<sup>2</sup> Total unit costs include 25% for engineering and administration

<sup>3</sup> Estimated replacement cost for total gravity wastewater system, based on 2019 dollars (ENR 11281)

## EXISTING WASTEWATER PUMP AND LIFT STATIONS

The Eugene service area currently includes 27 wastewater pump and lift stations, owned and operated by the City, in addition to two regional pump stations (Irvington and Willakenzie), owned and operated by MWMC. The number in each of the basins is shown below in Table 3-4.

<i>Table 3-4: Number of Wastewater Pump/Lift Stations in Eugene Service Area</i>	
<b>Major System Area</b>	<b>Number of Pump /Lift Stations</b>
Highway 99 Industrial area, including the Airport	5
River Road/Santa Clara	8
Willakenzie	5
Bethel	3
South West	0
Downtown	6
Laurel Hill	0
<b>Total</b>	<b>27</b>

An information summary on each pump station is shown in Table 3-5. Pump station locations are shown on Map 3-A.

#### ***Highway 99 Industrial Area and Airport Stations***

Five locally owned pump stations serve the Highway 99 industrial area and the Eugene Airport. The airport has three stations. The South Airport station serves a single hangar, and lifts the flow to the gravity system and into the Piper station, which is also a lift station. Additional flow is collected from the terminal and other development north of the terminal, all of which flows into the Airport pump station. From there, a force main extends 5,500 feet, west on Awbrey Lane and south on Highway 99, which then converts to gravity to the Enid pump station.

The Enid station currently collects additional flow from developments along Airport Road. It is expected to be relocated and upsized to also serve development in the Clear Lake area as detailed in Chapter 7. The station pumps under Highway 99, ultimately converting back to gravity, and continuing on to the MWMC-owned Irvington station.

The fifth station is the Prairie Road pump station, located at Beltline Highway. The Prairie Road station, built in 1997, was sized to serve the area adjacent to Prairie Road from Kaiser Avenue to Maxwell Road. It is not anticipated that improvements will be necessary within the planning period.

The portion of the basin north of Auction Way is largely undeveloped. The 1992 USSMP identified the need for two additional pump stations to serve this area, and those stations are still indicated in this plan to be constructed.

#### ***River Road/Santa Clara Stations***

With the exception of two small sub-basins that drain to the River Avenue pump station or the West Bank interceptor, the River Road basin drains to the Skipper pump station located along the northwest boundary of the basin. This large site-built station pumps into the 30-inch force main coming from west Eugene.

There are two pump stations and four lift stations in the Santa Clara basin. All four lift stations (Santa Clara, Wilkes, Spring Creek and Lynnbrook) lift flow to a point where gravity takes it to the Irvington pump station. From Irvington, a 24-inch force main carries the flow to the 30- and 48-inch force mains coming from west Eugene. The Irvington pump station is a regional station because it handles flows to the MWMC biosolids farm to the north, and therefore is not addressed in this master plan.



The remaining two pump stations (Greenwich and Division) pump into the 30- and 48-inch force mains to the treatment plant. Division is a medium-sized station. Increased development may require an upgrade to this station. The Greenwich station is a large station but the basin is almost fully developed so upgrades are unlikely to be required.

### ***Willakenzie Stations***

All of the flow from the Willakenzie area is pumped across the Willamette River by the Willakenzie pump station. The Willakenzie station is a regional station, maintained by MWMC.

The other major station in the Willakenzie area is the Oakway pump station, which is located on St. Andrews Drive near Oakway Road. This station has a 500-foot-long pressure line that lifts the flow back into the gravity system in Oakway Road. It was relocated and reconstructed in 2001.

The other four stations in the Willakenzie system are lift stations that serve fairly small, localized areas. All of these stations have two pumps, and no special issues are expected.

### ***Bethel Stations***

All of the wastewater from the South West and Bethel basins flows by gravity to the West Irwin, Terry Street and Barger pump stations in the Bethel basin. It is then pumped through two pressure lines (30-inch and 42-inch diameters) that extend east from each pump station, about 3.5 miles along Jessen Drive and Beltline Road to the wastewater treatment plant.

The West Irwin pump station was constructed in 1965 to serve the area annexed in 1964. This station has a limited wet well size, with an access-constrained drywell. In addition, the superstructure is unreinforced masonry that will not tolerate seismic activity. A replacement station is included in the City's capital improvement plan to be designed in 2020 and constructed in 2021.

The Terry Street pump station was constructed in 1984 to provide increased capacity for the South West basin. The station is in good condition, and major improvements are not likely to be needed in the planning period.

The Barger pump station was constructed in 1998. This pump station, included in the 1992 USSMP, was built to facilitate development within the UGB and was sized to accommodate flows from the South West basin as well as areas outside the UGB identified as urban reserve. Since that pump station was constructed, vast tracts of land in west Eugene were set aside as part of the West Eugene Wetlands. In addition, areas previously identified as urban reserve are no longer considered to be part of the future development. For these reasons, the Barger pump station has significant reserve capacity.

### ***Central Eugene Stations***

Flow from three of the four large basins of the Downtown group reaches the treatment plant by gravity through the 72-inch West Bank interceptor. The Downtown West basin flows to the Fillmore pump station, which then lifts the flow into the West Bank interceptor. Originally constructed in 1960, major modifications were added to the Fillmore station in 1995. The other five pump stations serve small localized areas.

Table 3-5: Existing Wastewater Pump Stations (Eugene Local) and Replacement Values

Name/Location	Year Built	(No. of Pumps) /HP	Firm Capacity (MGD)	Maximum Flow (MGD)	Estimated Replacement Cost * (\$ million)	Pump Station Features
<b>A. Highway 99 Industrial Area/Airport</b>						
Airport	2004	(2) 18	0.60	1.2	\$0.95	A, B, C,
Piper	1977	(2) 3	0.50	0.7	\$0.90	A, B
Airport South	1996	(2) 3	0.40	0.5	\$0.86	A, B, E
Enid	1985	(2) 20	2.38	4.0	\$1.72	C, D
Prairie Road	1997	(2) 88	3.30	5.4	\$2.12	A, B, C
<b>B. River Road/Santa Clara Areas</b>						
Skipper	1985	(2) 60	3.00	5.0	\$1.99	C, D
Division	1984	(2) 28	1.30	2.6	\$1.25	A, B, D
Greenwich	1985	(2) 30	1.00	1.5	\$1.12	B, C, D
Lynnbrook	1997	(2) 3	0.29	0.5	\$0.81	A, C, D, E
Wilkes	1985	(2) 7.5	0.50	0.8	\$0.90	A, B, D
Spring Creek	1985	(2) 7.5	0.50	0.8	\$0.90	A, B, D
North Santa	2001	(2) 10	0.60	0.9	\$0.95	A, C, E
River	1992	(2) 7.5	0.70	1.0	\$0.99	A, E
<b>C. Willakenzie Area</b>						
Oakway	2001	(3) 25	3.01	6.0	\$2.00	B, C
Spyglass	1977	(2) 4.7	0.60	0.9	\$0.95	A, B, D
Delta	1975	(2) 9.4	0.80	1.4	\$1.03	A, B
Tadmire	1978	(2) 3	0.50	0.8	\$0.90	A, B, D
Crimson	1997	(2) 30	2.14	3.6	\$1.62	E, A, C
<b>D. Bethel</b>						
West Irwin	1964	(3) 300	11.00	21.0	\$5.48	F
Terry Street	1984	(3) 200	6.60	14.0	\$3.56	F
Barger	1999	Note 1	3.60	6.2	\$2.25	A, F
<b>E. Central Eugene Area</b>						
Judkins Point	1954	(2) 10	0.29	0.5	\$0.81	A, D
Fillmore	1960	(2/3)	12.9	44.0	\$6.31	A, D
Tonawanda	1962	(2) 15	0.29	0.5	\$0.81	B, C, E
Foxcroft	1966	(2) 7.5	0.60	0.9	\$0.95	B, D, E
Willamette	1967	(2) 3.5	0.60	1.0	\$0.95	B, C, E
Riverfront	1990	(2) 5	0.40	0.6	\$0.86	A, B, C,
<b>Total Replacement Cost</b>					<b>\$43.93</b>	
<p><b>Notes:</b></p> <p>*ENR 11281; estimated replacement costs based on Table 6-4 plus 25% engineering and admin.</p> <p>Note 1 – Station has one 177 hp and one 130 hp pumps; designed for four 385 hp pumps</p> <p><b>Pump Station Features:</b></p> <p>A = Submersible pumps                      D = Pump around available</p> <p>B = No bypass available                      E = Package type station</p> <p>C = Emergency generator hookup      F = Two power sources</p>						

*Table 3-6: Existing Wastewater System Estimated Replacement Value – Pressure System*

<b>Pipe diameter (inches)</b>	<b>Average trench depth (feet)</b>	<b>System length (feet)</b>	<b>Construction cost<sup>1</sup> (per foot)</b>	<b>Total unit cost<sup>2</sup> (per foot)</b>	<b>Total cost of reconstruction</b>
4	4	543	\$56	\$70	\$38,136
6	4	6,214	\$67	\$84	\$521,560
8	4	5,364	\$76	\$96	\$512,853
10	4	1,031	\$93	\$117	\$120,117
12	4	4,189	\$108	\$135	\$563,859
14	4	115	\$156	\$196	\$22,483
16	5	7,876	\$168	\$210	\$1,656,902
28	5	7,871	\$255	\$319	\$2,508,052
30	6	13,018	\$271	\$338	\$4,405,133
36	7	60	\$418	\$522	\$31,341
42	7	13,118	\$506	\$633	\$8,304,477
72	10	266	\$900	\$1,125	\$299,234
<b>Total</b>		<b>59,665</b>			<b>\$18,984,148<sup>3</sup></b>

*Note: 2019 dollars (ENR 12281)*

<sup>1</sup> *Estimated construction costs are from Table 6-5 of this report for construction in developed areas.*

<sup>2</sup> *Total unit costs include 25% for engineering and administration.*

<sup>3</sup> *\$18.98 million is the estimated replacement cost for the total Eugene pressure wastewater system.*

## **SEISMIC ASSESSMENT OF THE WASTEWATER COLLECTION SYSTEM**

In 2016 a seismic assessment of the wastewater collection system and locally owned pump stations was conducted to evaluate the expected performance of a moment magnitude 9.0 Cascadia Subduction Zone (CSZ) earthquake. The complete technical memo is included in Appendix A.





Permanent ground deformation (PGD) is one of the primary factors causing damage to buried pipes. Mapping done by the Oregon Department of Geology and Mineral Industries (DOGAMI) indicates a low probability of liquefaction along the Willamette River, and the south valley. There is a moderate probability of liquefaction along the south hills but, due to the slopes, most wastewater pipes are only 8 inches in diameter. The resulting damage would more likely cause infiltration in misaligned pipe joints, rather than a completely blocked pipe. According to the assessment, the City has in excess of 20,000 gravity wastewater line segments. The total number of line segments expected to experience some level of damage is fewer than 200.

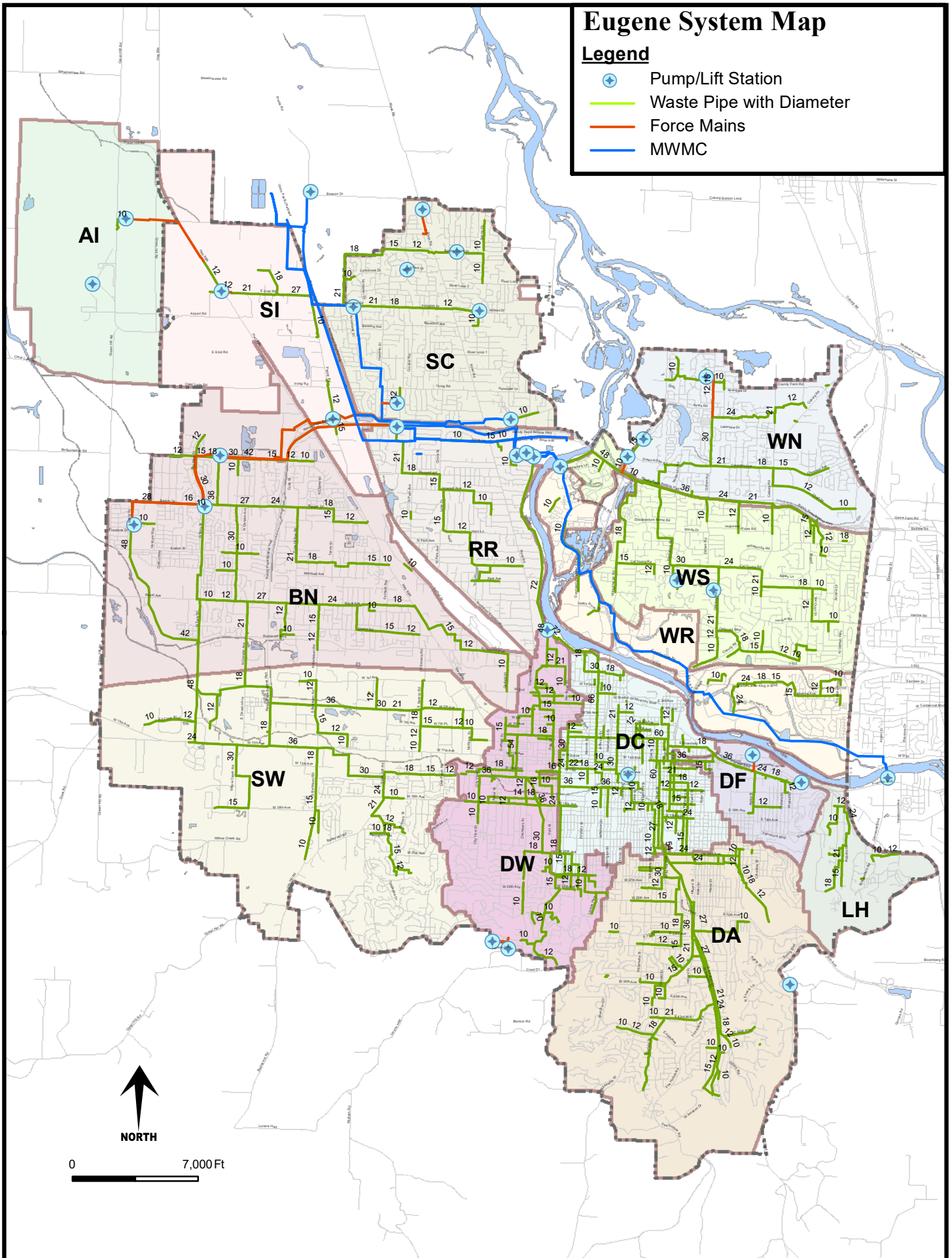
All of the pump stations are located in non- to low-liquefaction zones. Underground stations are expected to perform well, and with the exception of the West Irwin station (which is scheduled to be rebuilt), above ground stations are also expected to perform well. The primary issues associated with pump stations are loss of power and the potential to misalign influent and effluent pipes.

Given that the majority of Eugene falls in the low probability of PGD, the current design and construction specifications utilizing bell and spigot PVC are suitable for gravity wastewater pipe, and welded HDPE for force mains. New pump stations should be designed to current seismic standards with special attention to the influent and effluent pipe connections to the structure.

# Eugene System Map

## Legend

-  Pump/Lift Station
-  Waste Pipe with Diameter
-  Force Mains
-  MWMC



Basin Flow Diagram West Eugene

XXXX

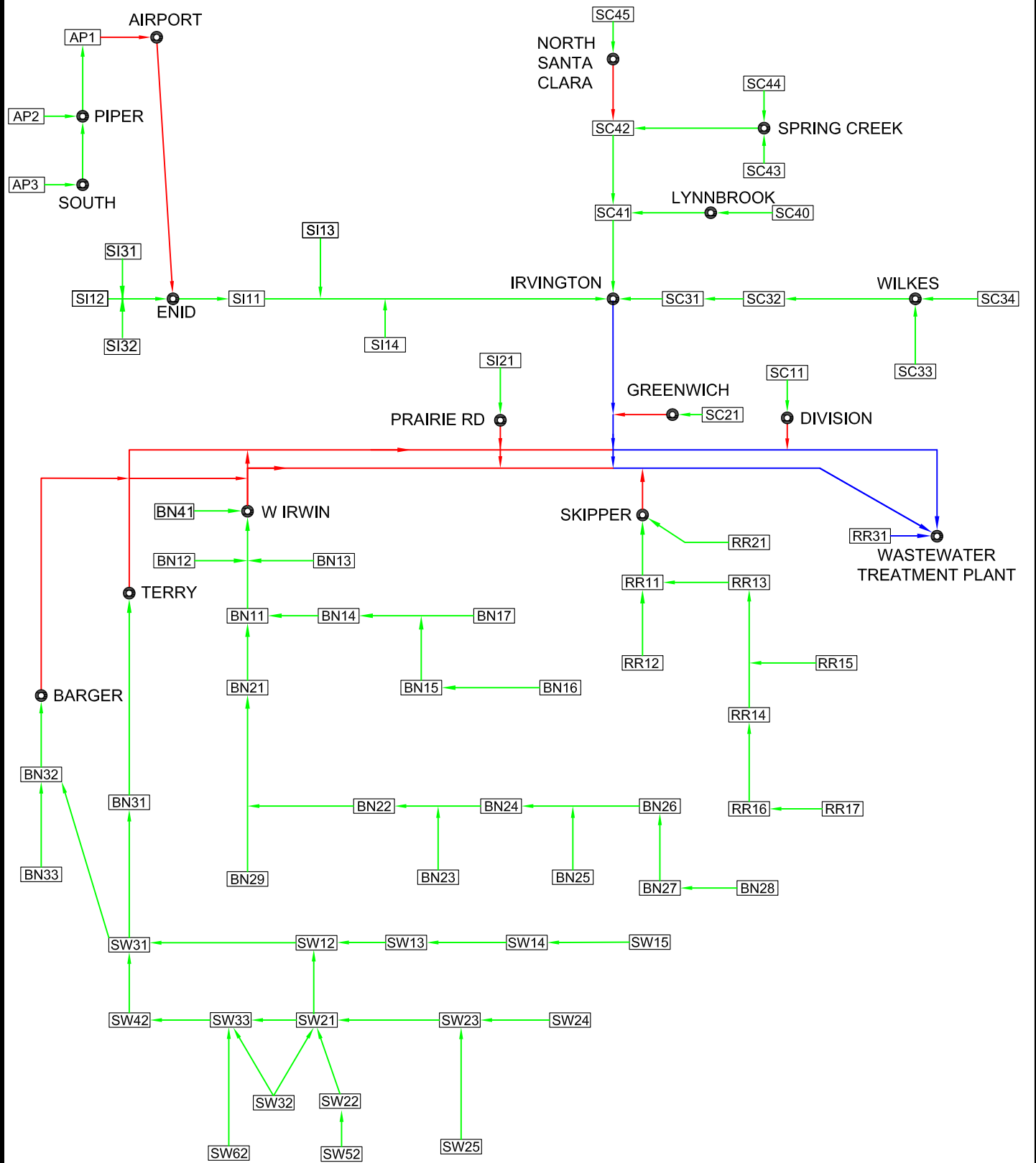
SUB-BASIN NUMBER

PUMP/LIFT STATION

WASTE PIPE

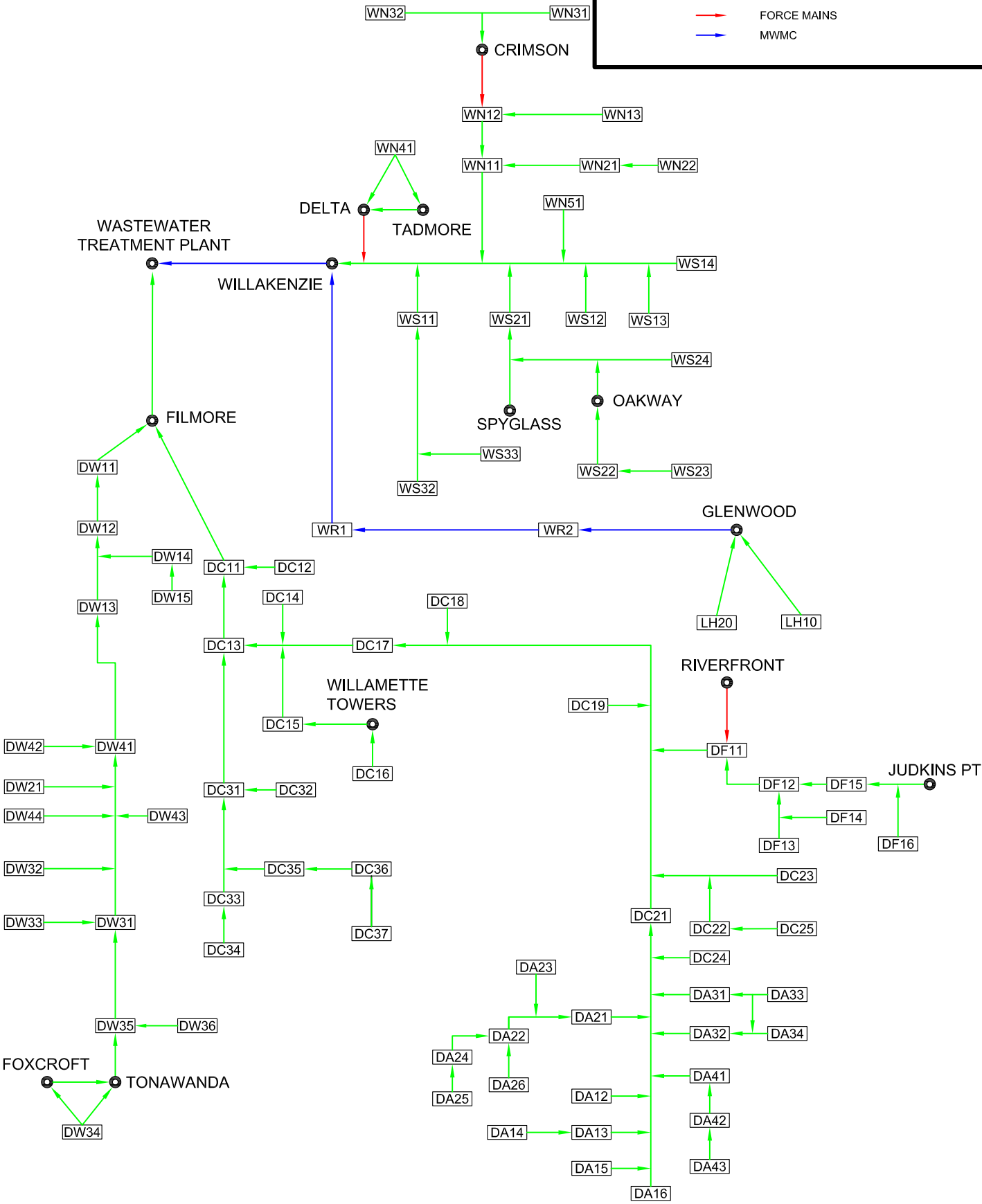
FORCE MAINS

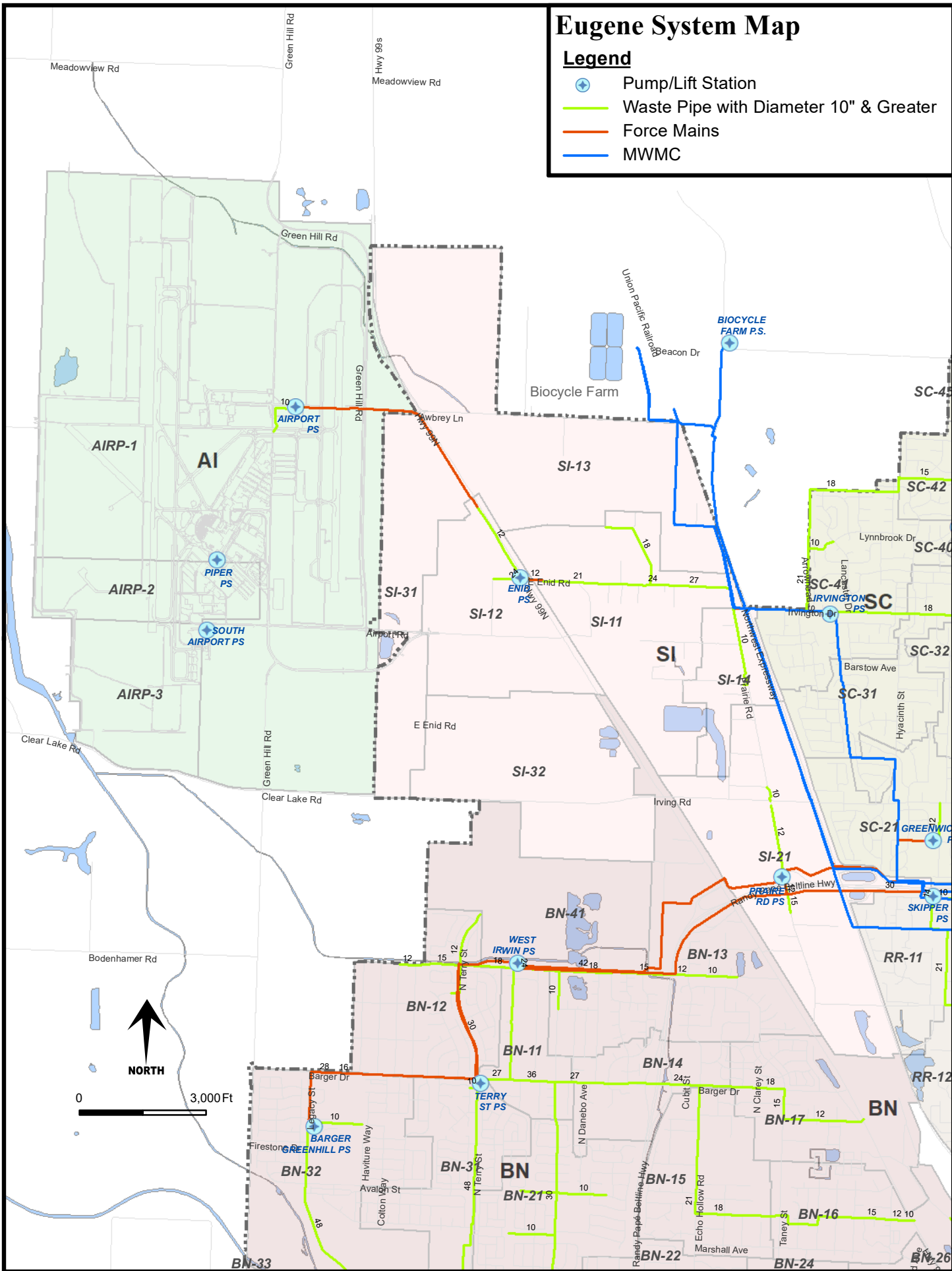
MWMC



Basin Flow Diagram East Eugene

- XXXX SUB-BASIN NUMBER
- PUMP/LIFT STATION
- WASTE PIPE
- FORCE MAINS
- MWMC











# Eugene System Map

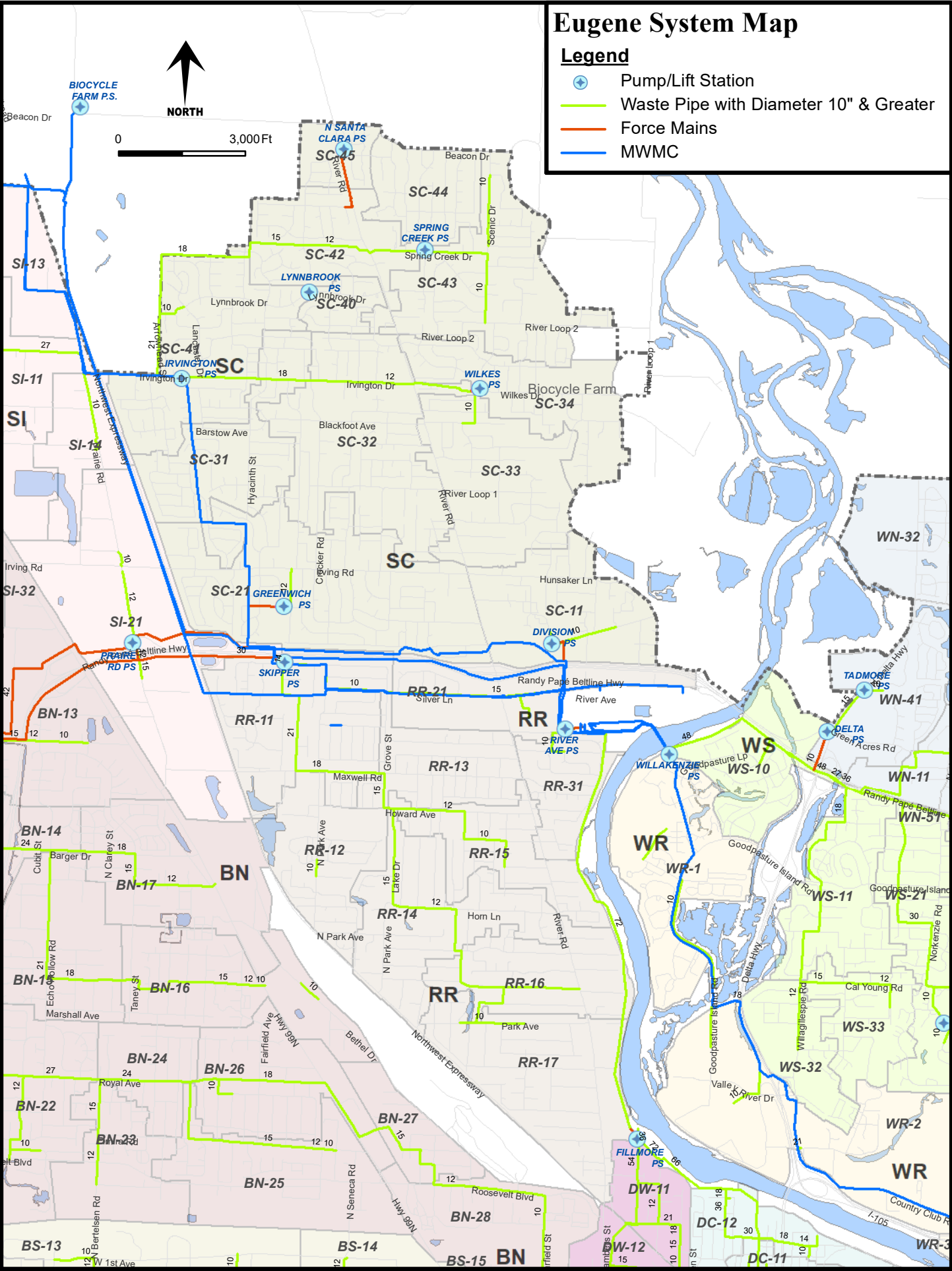
**Legend**

 Pump/Lift Station

 Waste Pipe with Diameter 10" & Greater

 Force Mains

 MWWC







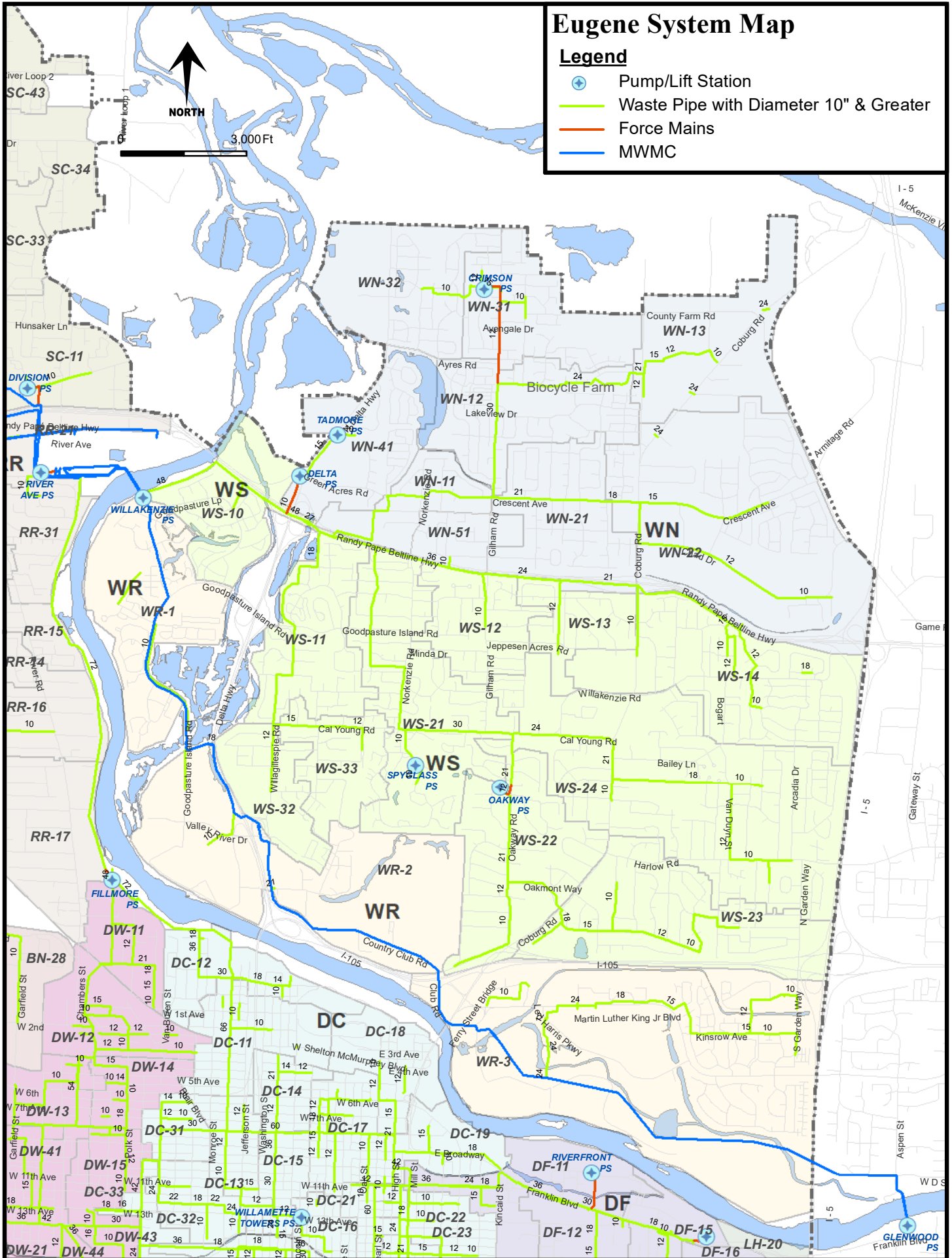


Map 3-F: Willakenzie North, Willakenzie South and Willamette River (WN, WS & WR)

# Eugene System Map





## Legend

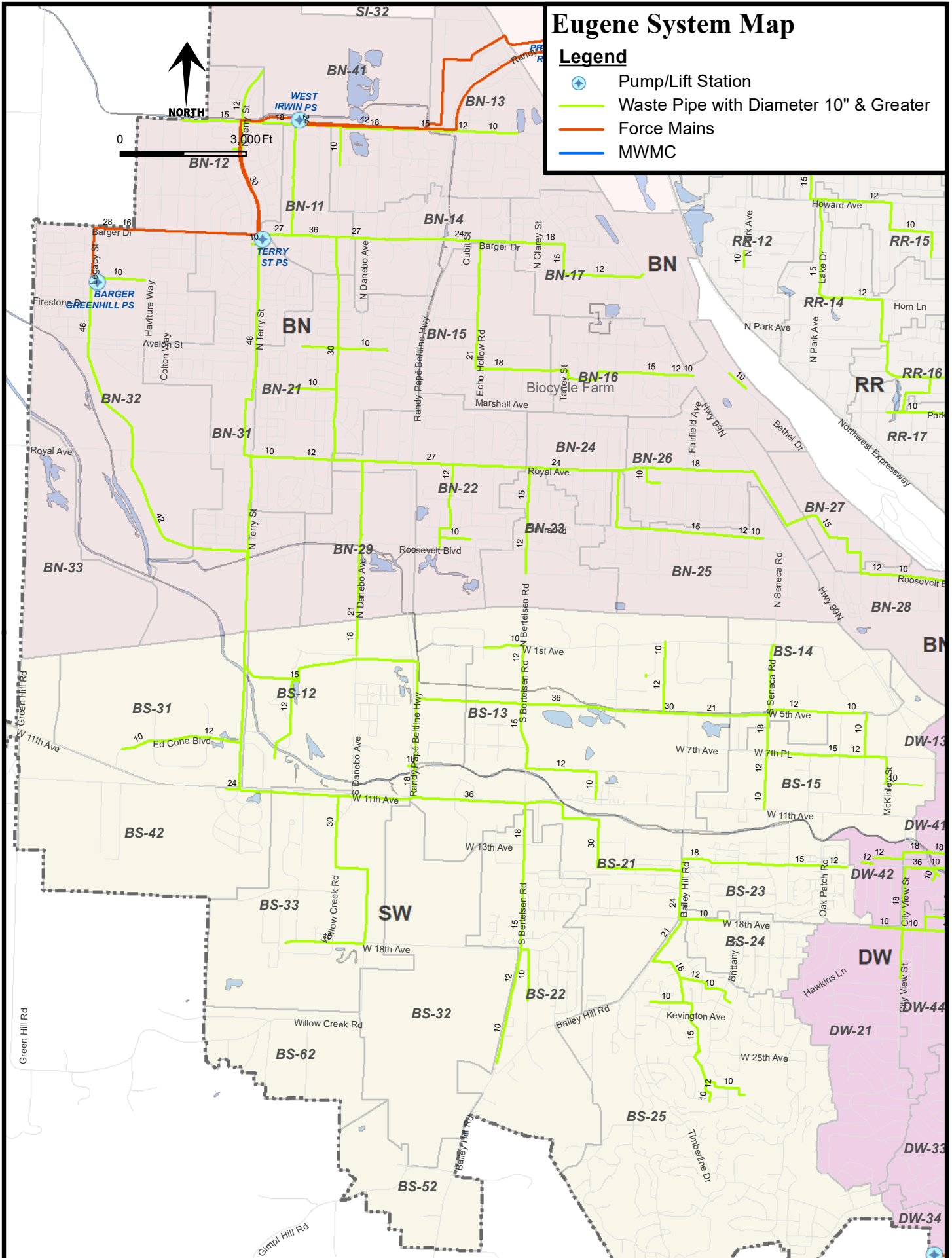
-  Pump/Lift Station
-  Waste Pipe with Diameter 10" & Greater
-  Force Mains
-  MWWC



# Eugene System Map





## Legend

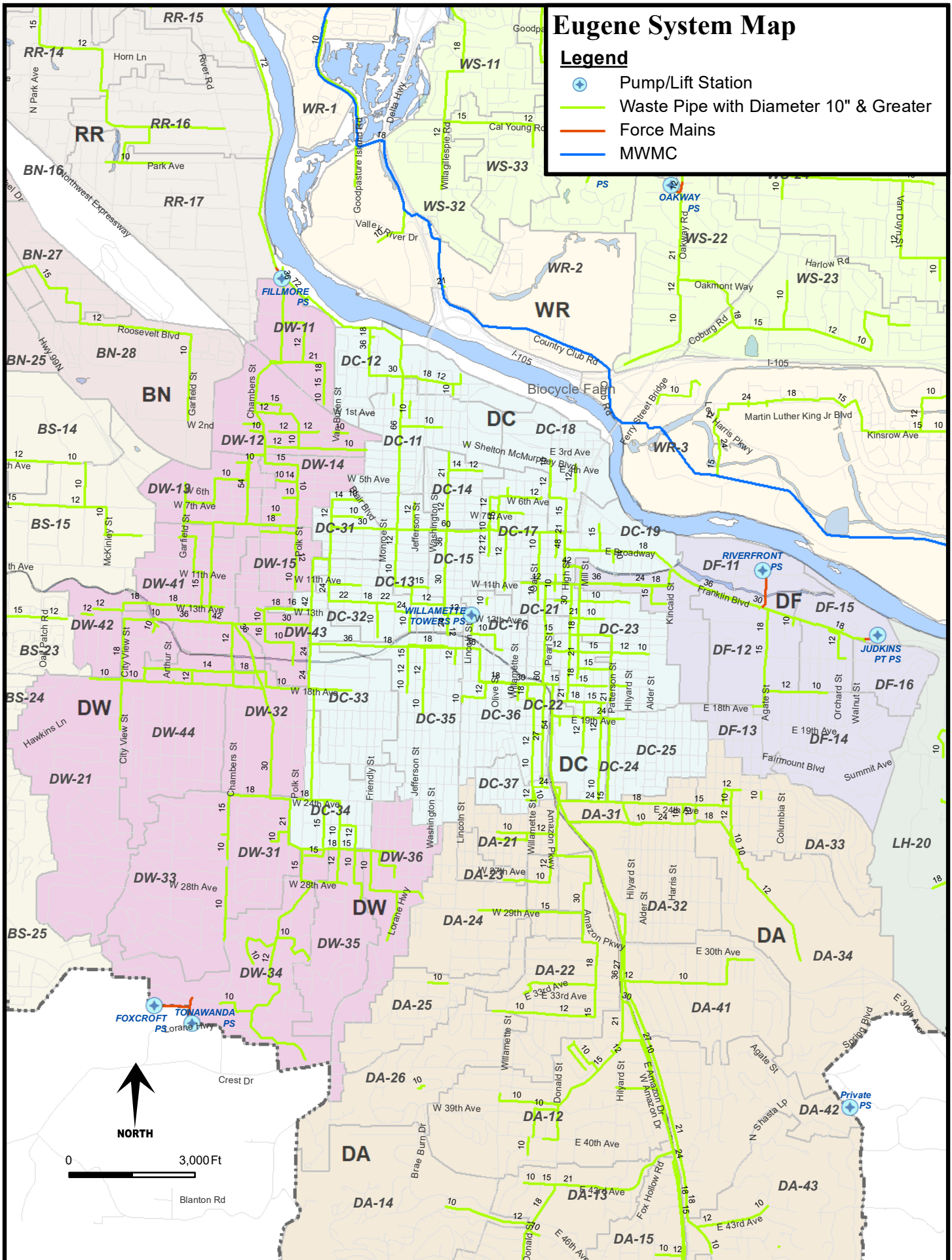
-  Pump/Lift Station
-  Waste Pipe with Diameter 10" & Greater
-  Force Mains
-  MWMC



# Eugene System Map

## Legend





-  Pump/Lift Station
-  Waste Pipe with Diameter 10" & Greater
-  Force Mains
-  MWWC

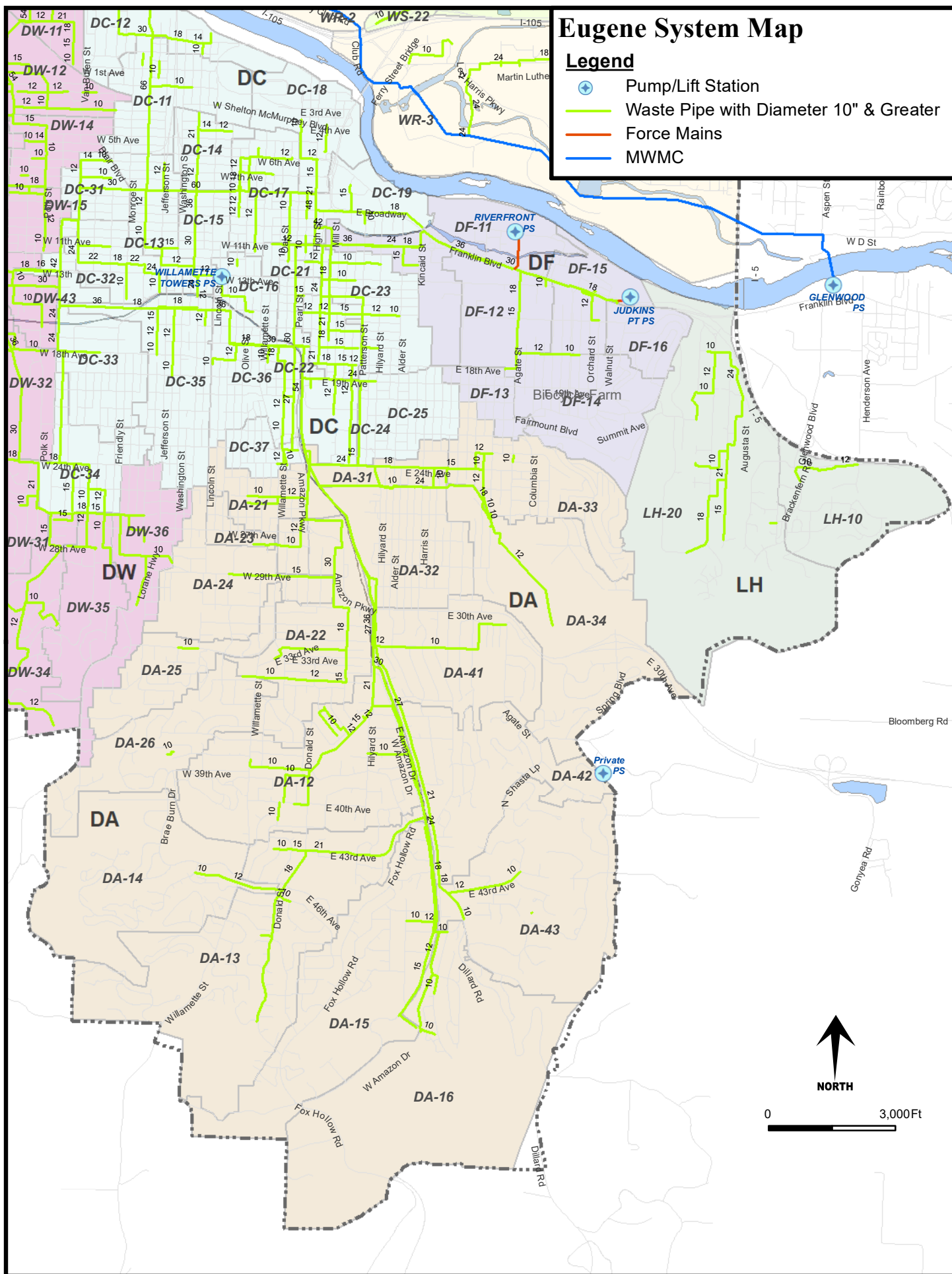


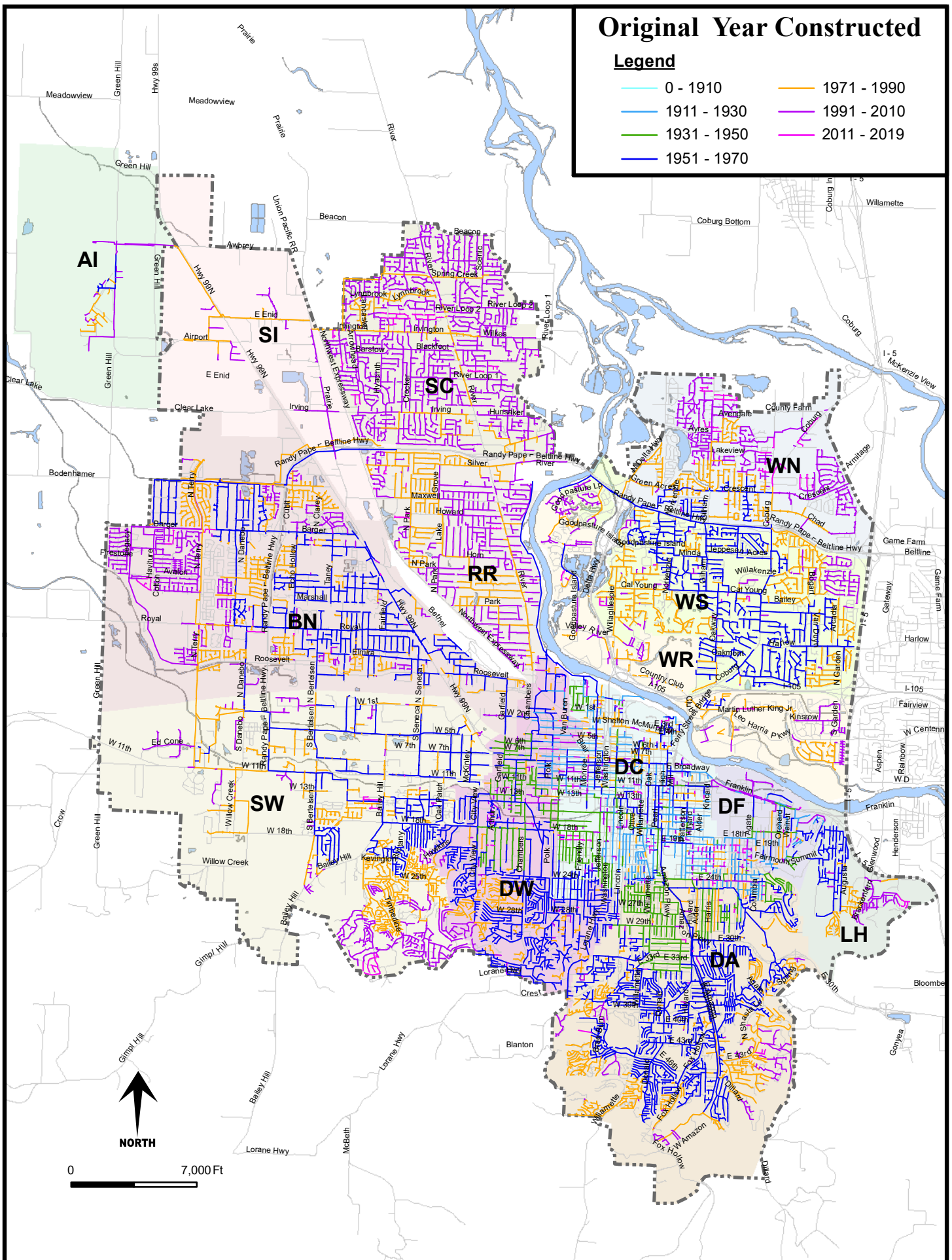


# Eugene System Map

## Legend

-  Pump/Lift Station
-  Waste Pipe with Diameter 10" & Greater
-  Force Mains
-  MWMC





## Chapter 4 - Design Criteria

### PURPOSE

The main purpose of this chapter is to standardize wastewater collection system design criteria for new development in the city of Eugene. These criteria utilize the best available land use and planning information and standardizes the calculation of design flows within the collection system.

The specific types of information needed to estimate collection system design flows are:

- **Land use designations** – Land use designations for the development under consideration, and all upstream contributing areas through the development.
- **Base wastewater flow** – Estimated daily average base wastewater flow rates for residential, commercial, and industrial users.
- **Peak flow factor** – A factor applied to the average base wastewater flow to estimate peak flow rates that occur during the day.
- **Peak infiltration/inflow** – The estimated peak flow rate for stormwater that enters the collection system through wastewater defects and unauthorized connections.

### LAND USE INFORMATION

Land use designations and population projections are the basis for estimating base wastewater flows in the collection system. Specific information about existing and projected land-use designations, can be obtained from the City of Eugene Planning and Development Department.

For purposes of long-range, general planning, Table 4-1 includes the land-use designations that are assumed to contribute wastewater flows to the system. Also included is a very brief description of allowed uses within each designation.

<i>Table 4-1: Land-Use Designation Categories Assumed to Contribute Flow to the Wastewater System</i>	
<b>Land Use Designation</b>	<b>Brief Description</b>
Low-Density Residential	One-family dwellings with some allowance for other types of dwellings. Up to 14 dwellings per net acre.
Medium-Density Residential	Medium-density residential use and encourage a variety of dwelling types. Allowed density between 10-28 dwellings per net acre
High-Density Residential	High-density residential use and is intended to provide an opportunity for a dense living environment. Allowed density 20-112 dwellings per net acre
Neighborhood Commercial Facilities	Generally, less than 5 acres, serving day to day needs.
Community Commercial Centers	Generally, 5 acres to 40 acres, include a wide range of purchaser goods and entertainment, office, and service needs for a support population smaller than that of the metropolitan area but larger than that of a neighborhood.

Major Retail Centers	Includes a wide range of purchaser goods, educational opportunities, entertainment, offices, travel accommodations, and services that attract people from the entire metropolitan area.
Campus Industrial	Designed for firms that will help achieve economic diversification objectives and that typically have a large number of employees per acre. Designed to provide sites for large-scale offices that provide a scientific and educational research function or directly serve manufacturing uses or other industrial or commercial enterprises.
Light-Medium Industrial	Industries that are often involved in the secondary processing of materials into components, the assembly of components into finished products, transportation, communication and utilities, wholesaling, and warehousing.
Heavy Industrial	A range of manufacturing uses including those involved in the processing of large volumes of raw materials into refined products and/or industrial uses that have significant external impacts.
Special Heavy Industrial	Areas designated to accommodate relocation of existing heavy industrial uses inside the UGB where there is not sufficient room for expansion and to accommodate a limited range of other heavy industries.
Park and Open Space	Areas that will conserve and preserve a variety of parks, recreation areas, and open spaces to maintain livability of the metropolitan area. Provides a balance of active and passive recreation opportunities to meet neighborhood, community, and metropolitan needs. Several facilities are allowed.
Government and Education	Government services and education campuses.
University/Research	Intended to accommodate light industrial, research and development, and office uses related to activities, research, and programs of the University of Oregon.
Mixed Use	This category represents areas where more than one use might be appropriate.

## BASE WASTEWATER FLOWS

Base wastewater flow is the average daily flow that originates from residential, commercial, and industrial users. If the collection system had no I/I, the base wastewater flow would be the total daily flow. Since I/I is very low during long periods of dry weather, base wastewater flow is also called average dry weather flow. The purpose of this section is to establish base wastewater flow rates that are generated by the 15 different land-use categories.

### ***Base Wastewater Flow Rates for Residential Areas***

Base wastewater flows generally relate closely to water consumption rates. In Exhibit 17 of the Eugene Water & Electric Board's 2004 Water System Master Plan, winter water consumption in the EWEB system was shown to be 150 gallons per household per day for residential use. Based on the 2010 census, the average occupancy rate is approximately 2.24 persons per dwelling unit, resulting in the flow

rate of 67 gal/capita/day. This flow rate is less than the 1992 rate of 73 gal/capita/day, which is an expected result of low-flow fixtures and other water conservation efforts.

For new construction, the Envision Eugene Comprehensive Plan estimates the average number of dwelling units per gross acre for low-, medium- and high-density designated areas. Those units and the estimated base flow rates are shown in Table 4-2.

<i>Table 4-2: Estimated Base Flow Rates for Residential Land Use</i>				
<b>Type of Land Use (Designation)</b>	<b>Dwelling Units Per Gross Acre<sup>1</sup></b>	<b>Population Per Gross Acre<sup>2</sup></b>	<b>Base Flows Per Gross Acre<sup>3</sup></b>	<b>Base Flows Per Net Acre<sup>4</sup></b>
Low-Density Residential	4.0	9	600	750
Medium-Density Residential <sup>5</sup>	10.7	24	1,605	2,000
High-Density Residential	21.5	48	3,230	4,040
<sup>1</sup> From Envision Eugene Comprehensive Plan estimates				
<sup>2</sup> Dwelling units x 2.24 persons/DU – 2010 census				
<sup>3</sup> Population x 67 gal/capita/day – 2004 EWEB Water Master Plan				
<sup>4</sup> Gross acres include 25% street right-of-way. Flow per net acre = 1.25 x flow per gross acre.				
<sup>5</sup> Includes Row Houses				

#### **Base Wastewater Flow Rates for Commercial and Industrial Areas**

Commercial and industrial developments have a wide range of flow rates. This is due to the variety of products, services, and intensity of site development that may occur. Without specific development plans, base wastewater flow rates can be estimated on a basis of mixed development. The 1992 USSMP included a detailed analysis to establish base wastewater flow rates for each of the major land use categories. A thorough review of that analysis was completed, in addition to a review of current master plans for EWEB and the City of Springfield, and a review of current industrial wastewater permits. It has been determined that there is no basis to modify the methodology included in the 1992 plan. A copy of that analysis is included in Appendix B of this document.

In addition to the four commercial and two industrial base flow rates included in the 1992 master plan (see Table 4-3), one additional category has been established: Campus Industrial. A brief description of this is included in Table 4-1. Calculation of base wastewater flow rates are described below.

#### **Campus Industrial**

An economic opportunities analysis prepared by ECONorthwest as part of the Envision Eugene process found an average of about 21 persons/acre on a sample of Campus Industrial sites in Eugene (see Envision Eugene Comprehensive Plan, Employment Land Supply Study, Part II, Table 25.) The study is planning for 10 employees per acre on industrial sites smaller than 10 acres (Table 31) and 6 to 14 employees per acres on industrial sites larger than 10 acres (Table 32). The Campus Industrial land-use category could include industries that have a varying water demand, but also may have less dense development than other commercial/industrial uses. Utilizing the per capita rate of 67 gallons may grossly underestimate the flow rate. A more reasonable value similar to the Light-Medium Industrial rate of 3,040 gallons per gross acre per day provides a factor of safety.

At best these flow rates are rough estimates that may be used for preliminary planning and system design. They may be checked against actual water usage in existing commercial developments and



adjusted as necessary. More accurate estimates can be made when specific site plans are developed, and then actual flow rates can be determined when the development is in operation. This process would allow preliminary design flow rates to be verified and provides more valid information to monitor system capacities.

## **PEAK FLOW FACTOR**

The preceding sections have established estimates of average base wastewater flows for proposed developments. Average base wastewater flow is defined as the average daily wastewater contribution from residential, commercial, and industrial users. To determine the required pipe sizes for the wastewater collection system, estimates of the peak *hourly* flow rate are required. Residential, commercial, and industrial flows typically follow a regular pattern, the maximum peak occurring in the morning and a lesser peak generally occurring in the evening. The peaks correspond to high water usage in homes, commercial institutions, and industries.

The 1992 USSMP includes an extensive analysis for the development of the peak flow factor used in Eugene and there is no basis to modify this methodology. The base peak flow factor should not be more than 3.5 nor less than 1.5. It is based on an exponential curve which can be calculated by the formula:

Peak Flow Factor =  $25 - 20.20 (\text{ADWF})^{0.0165}$  where ADWF = average dry-weather flow expressed in 1000s of gallons/day.

### ***Design Depth of Flow***

Wastewater systems are often designed to flow at a d/D ratio (depth of peak flow/pipe diameter) of 0.5 to 0.7 during peak flow conditions. This serves two purposes:

- Maintains ventilation throughout the pipeline.
- Provides some reserve capacity for future flow increases which may occur from land use or zoning changes, high-volume commercial or industrial businesses, or concentration of high-volume users in certain areas.

To simplify the design process, the peak flow factor has been calculated to provide a variable safety factor. When the proposed design criteria indicate a pipe is flowing full, the actual d/D ratio (depth of peak flow/pipe diameter) is estimated to vary from 0.65 for 8-inch pipes to 0.85 for 60-inch pipes. This allows the designer to accurately select pipe sizes based on their capacity when flowing full.

## **INFILTRATION/INFLOW**

### ***General***

*Infiltration/inflow (I/I)*, combined with *peak base wastewater flow* from residential, commercial, and industrial users makes up the total collection system design flow. In the Eugene collection system, I/I constitutes a majority of the total peak flow during the wet weather periods of the year.

Total infiltration/inflow consists of two components:

- *Groundwater infiltration (GWI)* occurs when a non-watertight wastewater pipe or structure is submerged or partially submerged beneath the groundwater table.

- *Rainfall-dependent I/I (RDI/I)* occurs during and shortly after a rainfall event and includes both infiltration and inflow. The stormwater inflow results from surface runoff sources and the rainfall-dependent infiltration (RDI) results from saturated soil conditions.

Various factors influence the I/I flow rate. GWI peaks during the high groundwater period, usually between January and March. The RDI peak occurs when the soil is highly saturated and has limited capacity to store additional water.

### ***New Systems***

New system design should not allow stormwater inflow. Ongoing system management and inspection will prevent connection of catch basins, area drains, and roof drains to the wastewater systems. An allowance for infiltration should still be included because pipe and joint materials will develop some defects during the long service life of the system.

New pipe materials are expected to have a service life of 100 years or more. Over that long service life, considerable damage should be expected. Therefore, the recommended peak I/I rate for new wastewater system design is:

2000 gal/gross acre/day or 2500 gal/net acre/day

This is an increase from the previous master plan but is consistent with the DEQ recommendation and the criteria used in the MWMC Facility Plan.

### ***Existing Systems***

For basins and study areas that include an existing wastewater system, an allowance for both infiltration and inflow must be included for the existing system. Peak I/I flow rates can vary widely, depending on the decade of construction, material type and groundwater conditions. Because of the complexity of variables causing I/I, rather than calculating a value based on these factors, the best way to estimate I/I is to use hydraulic model results for the study area. As the wastewater hydraulic model is developed, more and more basin-specific I/I rate data is becoming available. This data is based on field measured flow rates.

If the study area does not have model results available, estimate the capacity of an existing wastewater line by reviewing the age of the system, the type of pipe materials, and whether any rehabilitation has been completed. If this review indicates less than 50 percent of the system is rehabilitated or PVC pipe, the peak infiltration rate of 4000 gal/gross acre/day should be used.

## **SUMMARY OF PROPOSED DESIGN CRITERIA FOR NEW SYSTEMS**

This section provides a summary of the design criteria developed in the previous sections. The basic components of the design flow are shown in the following equation:

$$\text{Design Flow} = (\text{ADWF} \times \text{PFF}) + (\text{I/I})$$

where ADWF = Average Dry Weather Flow, PFF = Peak Flow Factor, and I/I = Infiltration and Inflow.

### ***Average Dry-Weather Flow***

The ADWF is the total of the base wastewater flows from all types of land use designations within the design basin, shown in Table 4-3. Refined flow information for specific developments (especially

commercial and industrial) should be used when available. Flow rates are provided for both *gross* and *net* acres. Gross areas are for the entire development site, including street areas. Net areas are for lots and development areas only and assume 25 percent of the gross area is used for streets.

<i>Table 4-3: Summary of Design Wastewater Flow Rates for New Developments</i>		
	<b>Gross Acre Design</b>	<b>Net Acre Design</b>
<b>Land Use Category</b>	<b>Base flow Rate (Gal/Acre/Day)</b>	<b>Base flow Rate (Gal/Acre/Day)</b>
Low-Density Residential	600	750
Medium-Density Residential	1605	2000
High-Density Residential	3230	4040
Neighborhood Commercial Facilities	1360	1700
Community Commercial Center/Mixed Use	2000	2500
Major Retail Center	2560	3200
Campus Industrial	3040	3800
Light-Medium/Special Heavy Industrial	3040	3800
Heavy Industrial	1520	1900
Park and Open Space	Consult park master plan for use intensity	
Government and Education/University Research	2680	3350

#### **Peak Flow Factor (PFF)**

The peak flow factor simulates the peak hourly base wastewater flow rate that occurs during the day.

The PFF varies between 3.5 and 1.5, depending on the total average dry-weather flow from the basin area. The PFF can be calculated from the following equation:

$$\text{Peak Flow Factor} = 25 - 20.2 (\text{ADWF})^{0.0165}$$

where ADWF is the total average dry-weather flow from the basin or study area, expressed in 1000s of gallons per day.

Example: Total ADWF for the basin is 600,000 gal/day

$$\begin{aligned} \text{PFF} &= 25 - 20.2 (600)^{0.0165} \\ &= 25 - 20.2 (1.11) = 2.55 \end{aligned}$$

#### **Infiltration/Inflow - New Development Areas**

For new development, an allowance is made for peak infiltration at the following rates:

##### **Peak Infiltration Rates**

<i>Type of Land Use</i>	<i>Gal/Gross Acre/Day</i>	<i>Gal/Net Acre/Day</i>
All Types	2,000	2,500

### Example Calculation

The following is an example calculated using wastewater flow rates in Table 4-3:

Preliminary development plan for a site containing 100 *gross* acres:

- 10 acres Neighborhood Commercial
- 10 acres Light-Medium Industrial
- 60 acres Low-Density Residential
- 20 acres Medium-Density Residential

<b>Land Use</b>	<b>Site Area (Gross Acres)</b>	<b>Base Flow Rate (Gal/Acre/Day)</b>	<b>Average Dry Weather Flow (1,000 Gal/Day)</b>
Low-Density Residential	60	600	36.0
Medium-Density Residential	20	1,605	32.1
Neighborhood Commercial	10	1,360	13.6
Light/Medium Industrial	10	3,040	30.4
Total Average Base Flow (Kgal/day) = 112.1 Peak Base Flow (Kgal/day) <sup>1</sup> = 354.7 Infiltration (Kgal/day) <sup>2</sup> = 200.0 Peak Design Flow (Kgal/day) = 554.7 Peak Design Flow (CFS) = 0.860			
<sup>1</sup> Peak Flow Factor = $25 - 20.2 (112.1)^{0.0165}$ <sup>2</sup> Infiltration = 100 gross acres at the rate of 2,000 GAD			

## Chapter 5 - Rehabilitation of Existing Wastewater Systems

### PURPOSE

The purpose of this chapter is to document current and past pipe rehabilitation efforts, outline methods for determining future rehabilitation priorities, and propose a level of funding necessary to fully address long-term preservation of the system based on projected design life and capacity of system components.

### GENERAL

The preservation needs of the wastewater system fall into two categories: structural problems and excessive I/I.

**Structural problems:** As detailed in Table 5-1, 29 percent of the system, which is approximately one million feet of pipe, was constructed at least 50 years ago and not rehabilitated as of 2019. Studies indicate that this may approach the design life of concrete pipe materials, particularly those installed before advanced gasket technology was available. Prior to the mid-1970s, wastewater pipe was constructed with concrete, clay, or transite. Although these materials are generally good for this application, over decades they are subject to chemical erosion, and the jointing materials deteriorate, allowing ground water to infiltrate. Investigations into the older parts of the system indicate that the majority of infiltration is coming from these older pipes. Today's installations only allow PVC, HDPE and ductile iron pipe which are chemically resistant, and have superior jointing materials.

Currently, the City of Eugene rehabilitates approximately 9,000 feet of old pipe per year. However, the collection system is aging much faster than we can rehab it. As of 2019, 34 percent of the system was at least 50 years old. By 2029 that number jumps to 49 percent. As a result, Eugene can expect more structural problems and emergency repairs unless an accelerated rehabilitation program is established.

<i>Table 5-1: Age of Unrehabilitated Gravity Pipe Collection System</i>				
<b>Decade of Construction</b>	<b>Length of Pipe Constructed</b>	<b>Rehabilitated Pipe</b>	<b>Unrehabilitated Pipe</b>	<b>Percent Unrehabilitated</b>
1912-1919	43,685	24,531	19,154	44%
1920-1929	90,958	65,291	25,666	28%
1930-1939	23,804	12,041	11,764	49%
1940-1949	141,521	75,167	66,354	47%
1950-1959	336,789	200,876	135,913	40%
1960-1969	925,151	112,844	812,307	88%
1970-1979	617,267	41,605	575,662	93%
1980-1989	337,284	9,200	328,084	97%
1990-1999	850,484	6181	844,304	99%
2000-2009	273,154	1465	271,689	99%
2010-2019	88,218	147	88,071	100%
<b>Total</b>	<b>3,728,314</b>	<b>549,347</b>	<b>3,178,967</b>	<b>85%</b>
<i>50 years or older (as of 2019)</i>		<i>490,750</i>	<i>1,071,157</i>	<i>69%</i>

**Excessive infiltration and inflow:** In addition to age-related structural concerns, the older wastewater pipes are also the primary source of excessive I/I. Excessive I/I creates a series of related problems:

- **Treatment plant operation:** High water flow rates increase plant operational costs and reduce treatment effectiveness. Given that the Oregon Department of Environmental Quality wastewater discharge permits are issued with increasing restrictions, plant efficiency becomes more critical.
- **Treatment plant capacity:** The existing treatment plant was designed for a maximum hydraulic capacity of 277 MGD. The average dry weather flow at the plant is under 30 MGD. Since the completion of major upgrades to the plant, the maximum flow experienced at the plant has been 231 MGD. As development occurs in both Eugene and Springfield, reducing I/I is critical to maintaining flows within the design capacity of the plant.
- **Wastewater system capacity:** As indicated above, high I/I rates at the treatment plant are an indication of higher flows throughout the piped system. Increased I/I reduces the available capacity for development and densification.

These preservation needs can be addressed through a managed rehabilitation program. Map 5-A indicates the types and areas of rehabilitation that have taken place over the last 25 years, and Map 5B shows the type of current pipe materials.

## **WASTEWATER SYSTEM REHABILITATION PROGRAM**

Eugene's wastewater collection system rehabilitation program is primarily centered on the reduction of infiltration and inflow. The overall program consists of several rehabilitation methods and quality-control procedures addressing the operation, maintenance and preservation of Eugene's wastewater system.

### ***Methods for Problem Identification***

- **Smoke testing** is the process of flooding a blocked-off segment of the wastewater collection system with inert, artificial smoke to see where it emerges. It is used to locate collection system defects, improper connections, and storm-wastewater cross connections. System-wide smoke testing was done in the mid-1970s and again in the mid-2000s. Many defects were found in both public and private wastewater lines. A large percentage of the defects were corrected; however, it was not possible to determine the I/I reduction that was accomplished due to a lack of measurable data. Smoke testing in 2018 in the Friendly Street neighborhood, which lasted most of the summer, resulted in only 6 work orders and 2 notices to correct cross connections. Also, it was difficult to determine if the defects were public or private.
- **Video inspection** is the process of video recording the interior of a pipe using specialized equipment. It is used to observe and document pipe deficiencies (pipe cracks, offset joints, settlement or dips in the pipeline, root intrusion, protruding taps) and detect infiltration in the mains and laterals; The inspection program has been ongoing since about 1965 and is now on about a five-year cycle to inspect all pipes that are less than 24 inches in diameter.
- **Manhole inspection** is the process of manually investigating and reporting on the features of a wastewater manhole looking for infiltration in covers, frames, cones, structures, and connecting lines.
- **Flow monitoring** is the process of measuring the amount of water passing by a point in the wastewater system over time. It was started in 1989 and measures wastewater flow rates at key manholes throughout the system. Flow monitoring information has two key uses: it is used to

calibrate the wastewater model, and it helps locate areas with rehabilitation needs based on infiltration. The most important information is obtained during heavy rainstorm events which determines the existing amount of I/I. The flow monitoring is also used to measure flow before and after rehabilitation work to measure I/I reduction.

#### ***Methods for Correction and Quality Control***

- **Inflow source correction** eliminates stormwater that reaches the wastewater system through direct connections. Historically, the connections were identified by the smoke-testing program. Roof drains, area drains, foundation drains, catch basins, sump pumps, cross-connections, etc., are disconnected from the wastewater system and rerouted to the storm or street drainage system. Manhole covers are also a source of inflow. When leaking manhole covers are identified they are corrected.
- **Infiltration correction** needs to be accomplished in both the public wastewater system and the private building service lines to reduce flows caused by infiltration. Correction of pipe defects is accomplished in several ways: reconstruction; chemical grout; sealing; slip lining; and cured-in-place pipe (CIPP) lining..
- **Structural correction** is accomplished by reconstruction or lining. If pipe condition, pipe size, and capacity requirements are all acceptable, then structural conditions may be improved by lining the host pipe. Structural correction and I/I reduction are planned and constructed at the same time to allow use of the most cost-effective construction methods.
- **Wastewater construction inspection** is essential in new construction and equally important – and even more difficult – in rehab construction. The City has established construction specifications and performs comprehensive and thorough inspections. A trained engineering technician from the Engineering Division is provided to witness and document construction or rehabilitation. Special attention is paid to lateral connections, which can be a major source of infiltration.
- **Design and design review** of proposed wastewater systems is performed by the Engineering Division to ensure compliance with design criteria and public improvement design standards. Wastewater lines are constructed in public street rights-of-way whenever possible to provide best access for wastewater maintenance. When easement construction is necessary, more consideration is given to preserving maintenance access. Allowing the installation of private wastewater systems is minimized. When private systems are allowed, the owners must agree to provide equal construction, maintenance, and I/ I control. Long, private service lines within the public right-of-way are replaced with direct access into the public system where possible.

#### ***Wastewater Model Development***

Eugene's complex wastewater collection system has been simulated as a digital hydraulic model in DHI's Mike Urban software. This model allows Engineering to perform complex analyses on the wastewater collection system.

The model was substantially completed in 2016. It was developed and is maintained by in-house staff. The initial simulated network included only pipes 10 inches in diameter and larger and associated pump stations. The model was calibrated using 30 flow monitors which recorded both wet weather and dry weather flows. This calibration means that when a historical rainstorm is simulated, the model's output closely matches the graph of the measured flow for that storm.

For the model to be a useful tool, continued refinement, expansion, and maintenance of the model is necessary. A flow monitor only measures the flow at a discrete point, which then represents the wastewater system upstream of that point. With 30 initial flow monitor locations, each of those points represents many thousands of feet of pipe. Monitoring and modeling more points increases data resolution so that each measured flow represents fewer, more localized upstream pipes. The next milestone in model refinement is to reach flow data resolution at no larger than 50,000 feet.

Furthermore, by including only pipes 10 inches and greater in diameter, the initial model contained only 20 percent of existing wastewater pipes. As flow monitors are deployed in upstream reaches that were not included in the initial model, the model is expanded by adding the associated upstream network of 8-inch pipes. The location of these upstream monitors is often driven by measuring the flow in micro-basins to determine areas of extreme I/I for rehabilitation.

Map 5-C shows the layout of the model at the start of 2020. As seen on the map, there are localized areas that have been filled in with all existing 8-inch pipes. The map also shows all monitoring points where the model is currently calibrated.

The model is maintained by analyzing flow data over time. Some flow monitors are permanently deployed in key locations so that the model can be re-calibrated when system changes are detected.

### ***Rehabilitation Planning Process***

The rehabilitation needs of the wastewater system far exceed the available capital resources. Prioritizing projects requires integration of many factors, including an analysis of the wastewater model, review of flow monitoring data, video inspection, consideration of future development, operational capacity of pump stations, and available budget. These tasks are divided among the Engineering, Wastewater, Maintenance, and Administration divisions of Eugene Public Works.

Rehabilitation projects are generally identified 18 to 24 months prior to construction. The process to prioritize capital projects begins with updating the wastewater model and the ranked micro-basin list with the latest flow data. Engineering, Wastewater and Maintenance divisions meet to evaluate the current areas of high I/I on the ranked list. Generally, the micro-basin with the worst I/I is given the highest priority. However, the evaluation also includes:

- What areas of the city are expected to have development that could increase flows beyond the downstream capacity if I/I efforts do not take place?
- Are pump stations having operational difficulties due to high I/I rates upstream?
- What is the pipe type and age of the system under consideration?
- Which areas can be rehabilitated most efficiently within the budget?
- What system defects are causing an inordinate impact on Maintenance operations?

The next step is video inspection by Maintenance or a contractor in the selected micro-basin. These videos and reports enable the Engineering team to scope and design the capital rehabilitation project, including mains, cleanouts, laterals, and manholes. Engineering Division prepares and bids the project for construction. Once construction is complete, flow monitors are deployed to measure the effectiveness of the rehabilitation, and the flow monitoring data is once again used to update, expand, and refine the model.



The process is repeated continually. It is important to review the entire system each year due to changing priorities, new information, development trends, budget considerations, and operational needs.

### **Finance Planning**

Adequate funding for an effective wastewater rehabilitation program requires financial planning in two major areas:

- **Wastewater user charge administration and rate setting:** The local portion of the wastewater user charge supports operation, maintenance, and rehab of the existing wastewater systems and provides some capital improvement funding. The user charge will likely continue to be the main source of funding for the rehabilitation program. Any increase in user charges to support an expanded program must be coordinated with the regional user charge and implemented so as to avoid major impact on ratepayers.
- **Capital Improvement Program planning:** Wastewater rehabilitation improvements have generally been funded as a single program item in the CIP budget. This practice should continue, as specific areas and projects are defined annually based on current model outputs and other priorities as discussed above.

### **REHABILITATION OF PRIVATE SERVICE LATERALS**

Service laterals, which extend from the main wastewater line to a business or residence, have the potential to be major contributors to infiltration. Historically, when the mainline is rehabilitated, the portion of the service lateral from the mainline to the right of way is included in the rehabilitation project. From the right-of-way line to the business or residence, the pipe is private property. As long as it appears to be working, there is little incentive for the private owner to replace or repair the pipe regardless of its contribution of I/I into the wastewater system.

There is general agreement among wastewater professionals that I/I from private service laterals exacerbates peak flow issues in the wastewater collection and treatment system. Initial assessments of Eugene's flow monitoring data support this notion. An analysis done for the Metropolitan Wastewater Management Commission in 2015 offered a number of conclusions:

- Regulatory standards exist for the management of wet weather flows and the prohibition of sanitary sewer overflows.
- Substantial penalties are associated with noncompliance with the regulatory standards.
- The Eugene/Springfield Regional Water Pollution Control Facility experiences significant peak flows due to infiltration and inflow in the public and presumably the private segments of the sanitary sewer system. These peak flows increase the costs to collect and convey water in the sanitary system to the treatment plant, reduce treatment efficiency and increase treatment costs, and increase the potential for overflows from the sanitary sewer system.
- Significant funding and resources have been applied by MWMC and Eugene and Springfield to the repair and rehabilitation of the public segments of the sanitary sewer infrastructure, and to expanding the capacity of the regional treatment facility to accept and treat peak wet weather flows.
- Neither city has specific code requirements at this time related to the responsibilities for proper operation and maintenance of private service laterals connected to the public sanitary system.

- There is currently insufficient data to quantitatively document the contribution of I/I from private service laterals to the local or MWMC wastewater system.
- There is anecdotal evidence from Eugene and Springfield, and quantitative data from peer agencies, of the potential significance of these contributions.
- Eugene and Springfield have the capability to conduct flow monitoring of the sanitary sewer systems within their jurisdiction.
- There are case examples of, and practical experience with, private lateral programs of peer agencies that can be used for reference and guidance.

The full analysis and a list of possible actions to further evaluate the need for a program to address I/I from private service laterals is included as Appendix C.

## **REHABILITATION COSTS**

The costs of an effective wastewater rehabilitation program are determined by the method(s) used to rehabilitate the system, the size of the pipes and other infrastructure being rehabilitated, and the amounts of pipes needing rehabilitation. The costs are also affected by the quantity of public laterals and manholes attached to the mains undergoing rehab, which are typically rehabbed in complementary projects.

### ***Mainline Rehabilitation Unit Costs***

The three most common methods of wastewater rehab are: chemical grout sealing, cured-in-place pipe lining (CIPP), and reconstruction. Other methods of rehabilitation include slip lining and pipe bursting. In Eugene, slip lining is seldom used, and pipe bursting has been used on smaller pipe sizes but does not represent a significant portion of the rehabilitation program.

Chemical grout sealing performs best in deep lines with elevated ground water conditions that do not allow the grout to dry out. It is the least costly rehab method but does not provide any structural improvement to the pipeline. This method of rehab is best utilized for portions of the system difficult to access by other means, and costs vary significantly based on depth, size and the number of locations included in the contract.

Table 5-2 shows the estimated unit cost for the primary method of construction, cured-in-place pipe, (or CIPP). This method of rehabilitation not only provides a continuous, unjointed segment of pipe between manholes, but it performs as a structural improvement to the host pipe.

<i>Table 5-2: Estimated Construction Costs for Wastewater Rehabilitation Using Cured-In-Place Pipe (CIPP)</i>		
<b>Existing Wastewater Diameter</b>	<b>CIPP <sup>1</sup> (\$/foot)</b>	<b>Wastewater Reconstruction <sup>2</sup> (\$/foot)</b>
6"	\$129	\$138
8"	\$132	\$154
10"	\$134	\$168
12"	\$136	\$187
15"	\$141	\$199
18"	\$154	\$254
21"	\$165	\$284
24"	\$219	\$295
27"	\$251	\$347
30"	\$280	\$401
36"	\$325	\$467
42"	\$390	\$542
48"	\$447	\$666
54"	\$526	\$786
60"	\$730	\$894
66"	\$803	\$908
72"	\$958	\$917
<i>Note: 2019 construction costs: ENR = 11281</i> <sup>1</sup> CIPP costs includes replacing and reconnecting the service line to the ROW. <sup>2</sup> Wastewater reconstruction includes pavement removal and replacement. Costs shown are for a typical average depth based on the size of the pipe. Detailed reconstruction cost information is included in Chapter 6.		

### **Public Lateral Rehabilitation Costs**

Public laterals extend from the wastewater main to the property line. The primary method used to rehabilitate laterals in Eugene is CIPP lining. At 2019 prices, an average lateral (length 30 feet) costs about \$4,500 to CIPP line, which includes engineering costs.

### **Manhole Rehabilitation Costs**

Manholes are generally constructed with concrete and are therefore a potential source of inflow/infiltration as they age. The primary method used to rehabilitate manholes and restore their ability to protect against infiltration is grout sealing. At 2019 prices, sealing a manhole costs \$225/vertical foot and costs \$500 to seal the channel.

### **Long-Range Rehabilitation Planning**

As of 2019 there were approximately 717 miles of public wastewater lines. Of this approximately 202 miles of pipe were 50 years or older, without any type of rehabilitation performed on them, as shown in Table 5-1 and Table 5-3.

*Table 5-3: Construction Costs for Wastewater Rehabilitation Using Cured-In-Place Pipe (CIPP) for Existing Un-Rehabilitated Pipe Greater Than 50 Years Old (as of 2019)*

<b>Pipe Diameter</b>	<b>Un-Rehabilitated Pipe (ft)</b>	<b>CIPP Cost/Foot</b>	<b>Total Construction Cost<sup>1</sup></b>
5" -6"	30,526	\$129	\$3.95
8"	649,149	\$132	\$85.38
10"	64,125	\$134	\$8.58
12"	53,307	\$136	\$7.25
14"-15"	32,813	\$141	\$4.61
18"	60,443	\$154	\$9.31
21"	29,737	\$165	\$4.91
24"	17,176	\$219	\$3.77
27"	12,863	\$251	\$3.22
30"	32,820	\$280	\$9.19
36"	38,878	\$325	\$12.63
42"	3,543	\$390	\$1.38
48"	5,674	\$447	\$2.54
54"	11,851	\$526	\$6.23
60"	7,424	\$730	\$5.42
66"	7,276	\$803	\$5.84
72"	11,301	\$958	\$10.82
<b>Total</b>	<b>1,068,904</b>		<b>\$185.03</b>
<i>Note: cost estimates used 2019 Construction Costs, ENR =11281</i>			
<i><sup>1</sup> in millions of dollars</i>			

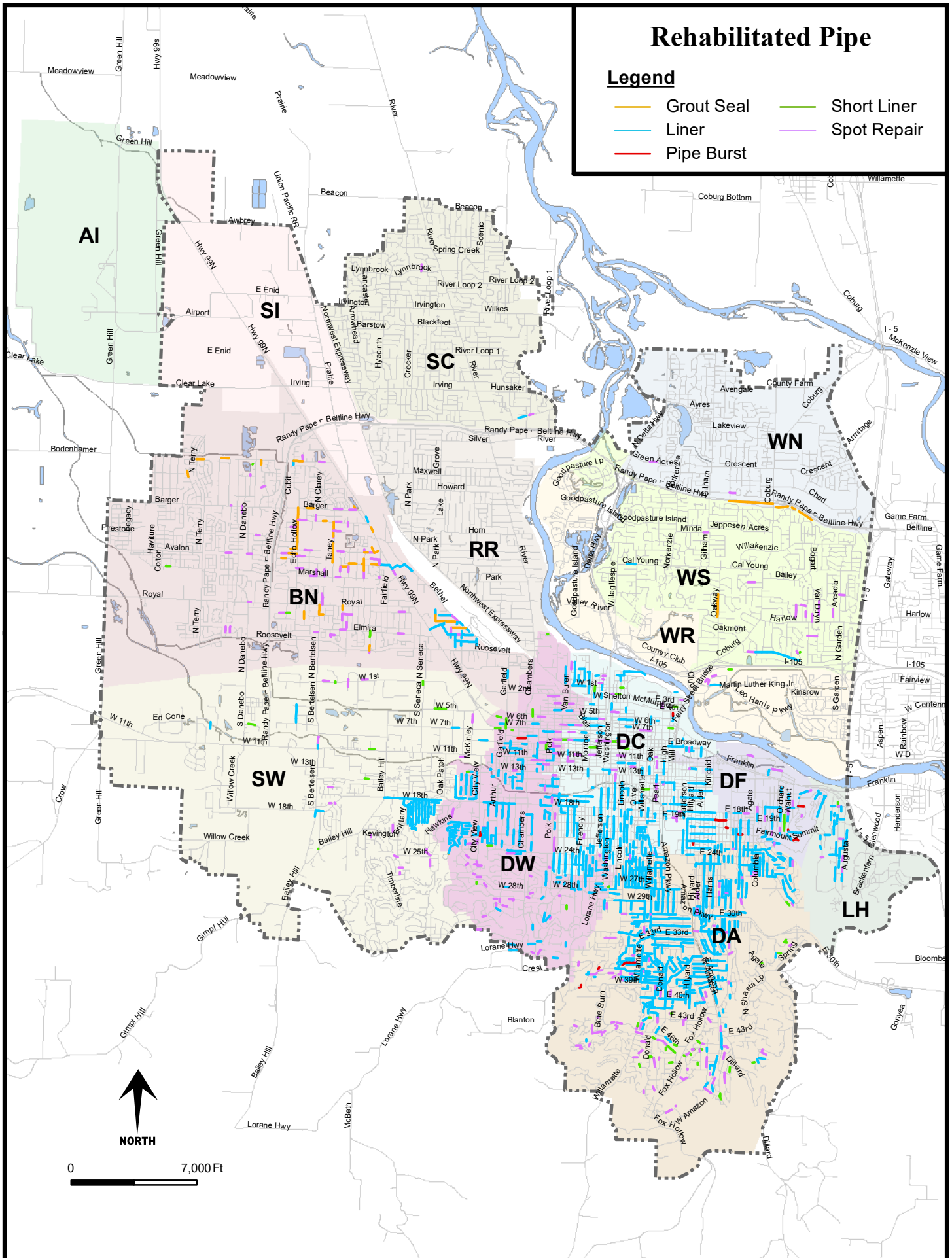
## ADDITIONAL INFORMATION

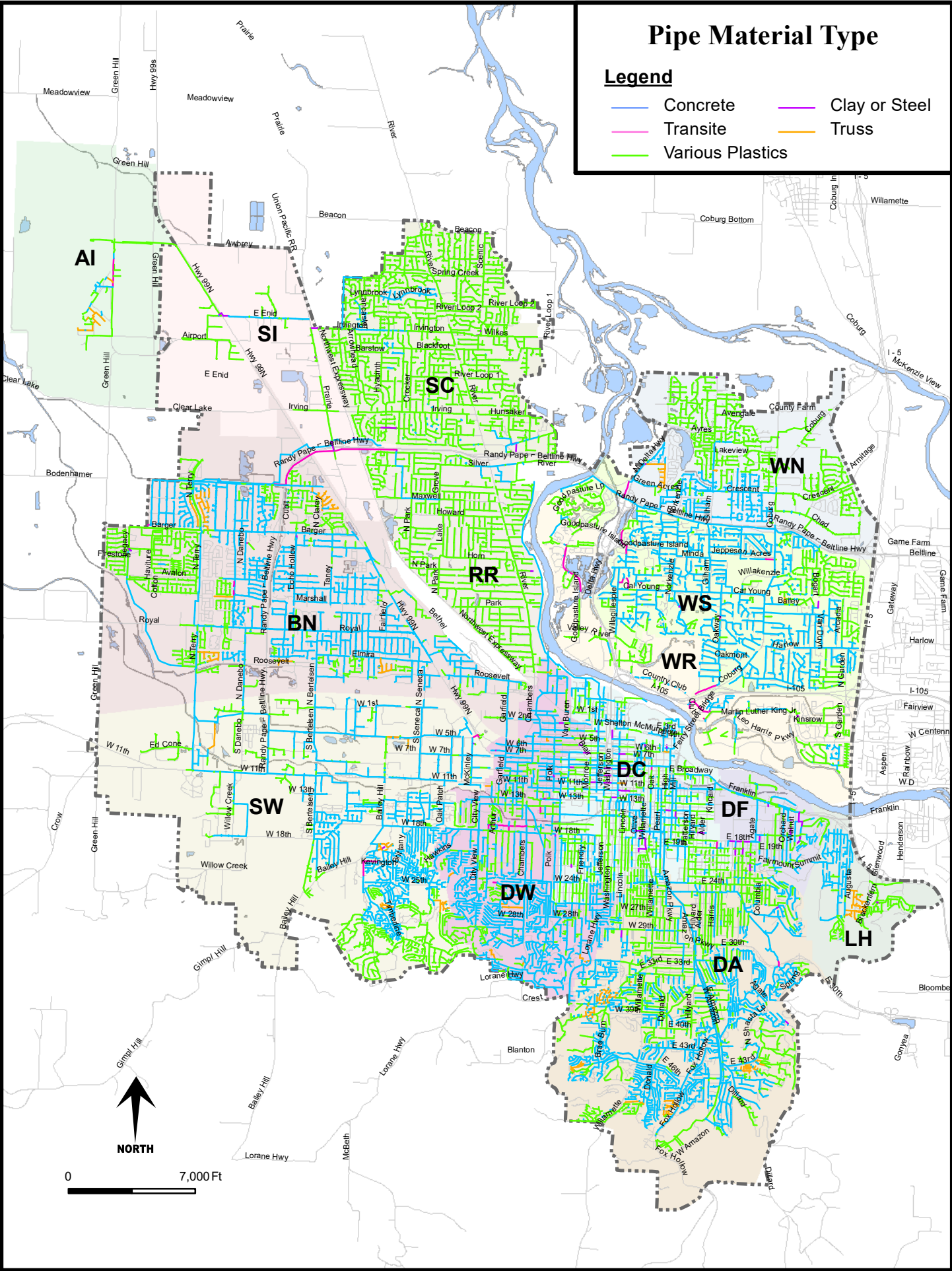
The fiscal year 2020 capital budget included \$1,755,000 for wastewater reconstruction and rehabilitation. In 2019, this represented less than 0.1 percent of the estimated replacement value of the wastewater collection system and only allowed for rehabilitation of approximately 11,000 feet of pipe. To help put that amount of rehab in perspective, an additional 70,000 feet of wastewater pipe reached the age of 50 in 2019 alone.

PVC was not the predominant pipe type until approximately the mid-1970s, and wasn't used exclusively for smaller diameter pipe until the 1980s. Most literature concludes that PVC can be expected to have a service life of 100 years, or more. In addition to the pipe material, the joint materials used in PVC pipe continue to improve, reducing I/I.

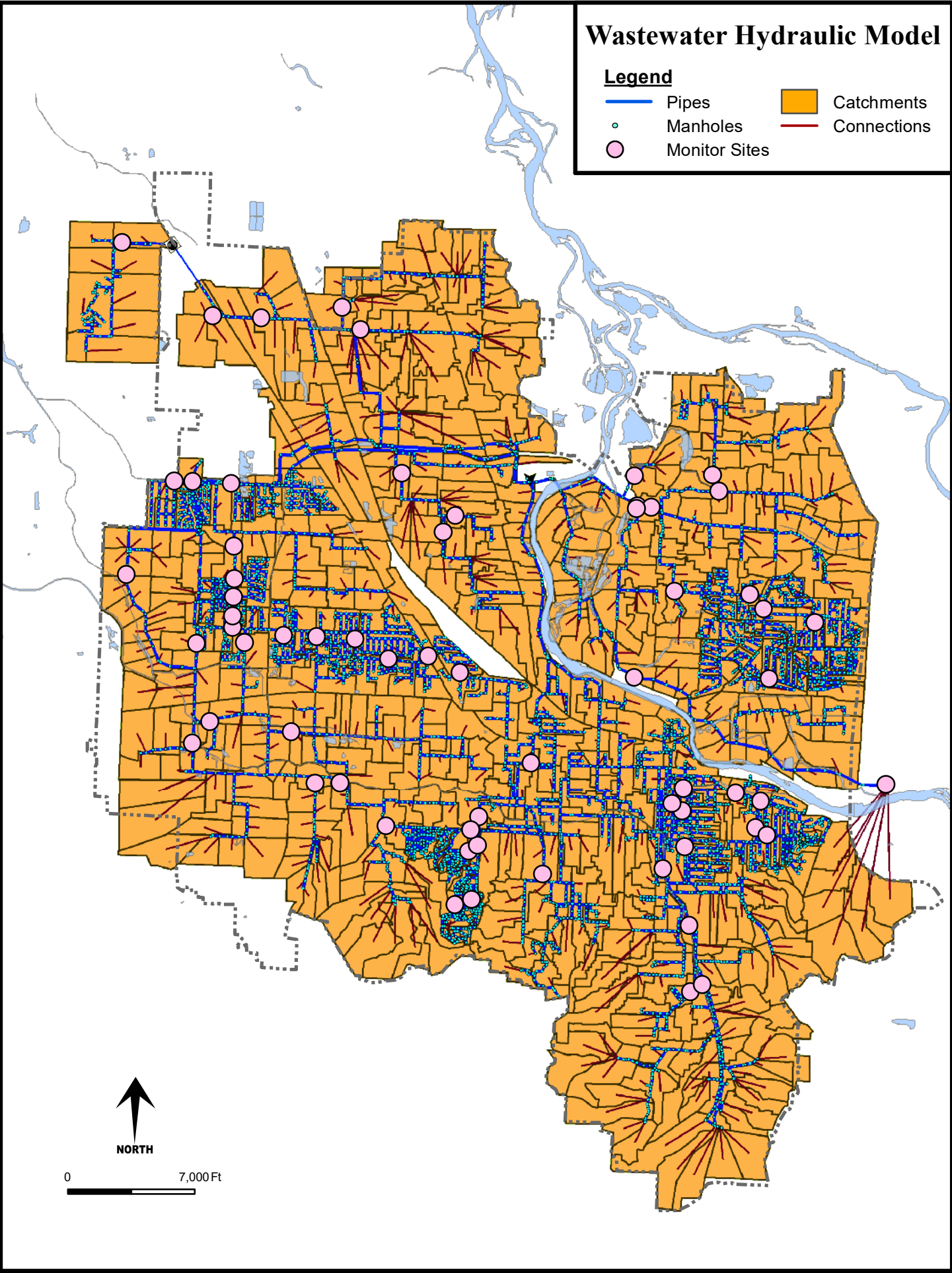
An added benefit of a fully funded wastewater rehabilitation program is improved resiliency of the system in the event of an earthquake. Continuous, lined gravity wastewater pipes are far less likely to separate during a seismic event.

Map 5-A: Rehabilitated Pipe by Type of Repair









## Chapter 6 - Basis of Cost Estimates

### PURPOSE

This chapter provides estimated construction costs for wastewater lines, wastewater pump stations, and pressure lines.

### GENERAL

The estimated costs presented in this chapter are primarily for development of long-range financial plans. Major new interceptors, trunk wastewater lines, pump stations, and pressure lines that may be constructed during the next 20 years are described in Chapter 7. This chapter shows the basic unit prices used to estimate the construction costs for these future wastewater projects.

### WASTEWATER CONSTRUCTION COSTS

Wastewater construction cost estimates are based on the 1998 Local Wastewater System Development Study completed by CH2MHill and have been adjusted to an *Engineering News-Record* (ENR) cost index of 11281, which was the average adjustment for 2019. This method was verified by comparing adjusted estimates to values from more recent cost estimating software.

The estimated costs per foot are shown for pipes from 6-inch through 72-inch diameters and for trench depths in 5-foot increments. The costs are estimated for two typical construction situations as shown in Table 6-1 and Table 6-2. The costs include a complete construction package for the main wastewater line, including manholes, excavation, pipe bedding, pipe materials, pipe laying, pipe zone backfill, appropriate trench backfill, air-pressure testing, TV inspection, and pavement removal and repair in the trench area where required.

The tables show costs for projects of average construction difficulty. When special conditions exist, such as high ground water, unstable trench, difficult traffic control, etc., costs should be increased. Costs for building service connection lines and other special features, such as pavement overlays beyond the trench area, also must be added if a more complete project estimate is needed.



<i>Table 6-1: Estimated Costs for Construction in Developed Areas</i>					
<b>Diameter (inches)</b>	<b>Depth (feet)</b>				
	<b>0-5</b>	<b>6-10</b>	<b>11-15</b>	<b>16-20</b>	<b>Over 21</b>
6	\$105.11	\$153.90	\$190.03	\$223.60	\$261.62
8	\$107.36	\$156.15	\$192.29	\$225.87	\$264.27
10	\$109.49	\$158.20	\$194.59	\$229.96	\$269.06
12	\$122.11	\$161.03	\$202.01	\$240.62	\$281.52
14	\$131.54	\$170.46	\$211.94	\$250.54	\$293.14
15	\$131.54	\$170.46	\$211.94	\$250.54	\$293.14
16		\$212.09	\$261.81	\$307.02	\$359.22
18		\$212.09	\$261.81	\$307.02	\$359.22
20		\$233.74	\$280.86	\$326.09	\$381.52
21		\$233.74	\$280.86	\$326.09	\$381.52
22		\$260.49	\$292.54	\$343.56	\$401.96
24		\$260.49	\$292.54	\$343.56	\$401.96
27		\$279.93	\$339.40	\$390.41	\$456.78
30		\$320.00	\$387.83	\$445.15	\$520.81
36		\$360.59	\$437.09	\$502.34	\$587.75
42		\$391.42	\$475.50	\$547.79	\$640.92
45		\$454.37	\$549.96	\$631.83	\$739.24
48		\$454.37	\$549.96	\$631.83	\$739.24
54		\$557.86	\$665.07	\$753.24	\$881.29
60		\$659.98	\$779.59	\$875.99	\$1,024.91
66		\$704.93	\$832.77	\$935.82	\$1,094.91
72		\$752.58	\$888.64	\$998.54	\$1,168.29
78			\$969.86	\$1,086.04	\$1,270.67
<i>Notes: Unit costs are for reconstruction in developed areas (ENR 11281). Excludes engineering. Includes 6 inches ACP</i>					

<i>Table 6-2: Estimated Costs for Construction in Undeveloped Areas</i>					
<b>Diameter (inches)</b>	<b>Depth (feet)</b>				
	<b>0-5</b>	<b>6-10</b>	<b>11-15</b>	<b>16-20</b>	<b>Over 21</b>
6	\$81.42	\$130.20	\$161.60	\$190.43	\$223.71
8	\$80.95	\$129.73	\$160.60	\$188.89	\$222.01
10	\$80.37	\$129.07	\$159.64	\$189.19	\$222.45
12	\$90.26	\$129.17	\$163.79	\$196.03	\$230.57
14	\$96.97	\$135.89	\$170.46	\$202.15	\$237.83
15	\$95.61	\$134.53	\$168.83	\$200.25	\$235.65
16		\$174.80	\$217.07	\$254.83	\$299.56
18		\$172.08	\$213.79	\$251.01	\$295.21
20		\$191.01	\$229.59	\$266.26	\$313.15
21		\$189.65	\$227.96	\$264.36	\$310.98
22		\$215.04	\$238.01	\$279.93	\$329.25
24		\$212.32	\$234.74	\$276.12	\$324.90
27		\$227.68	\$276.70	\$317.26	\$373.19
30		\$263.67	\$320.23	\$366.29	\$430.69
36		\$296.11	\$359.70	\$412.06	\$484.57
42		\$318.78	\$388.32	\$446.09	\$524.68
45		\$377.64	\$457.90	\$524.41	\$616.48
48		\$373.56	\$453.00	\$518.70	\$609.95
54		\$468.89	\$558.31	\$628.69	\$738.95
60		\$562.86	\$663.04	\$740.02	\$869.51
66		\$599.64	\$706.44	\$788.43	\$926.47
72		\$639.14	\$752.52	\$839.72	\$986.78
78			\$823.93	\$915.80	\$1,076.11
<i>Notes: Unit Costs are for construction in undeveloped areas (ENR 11281). Excludes engineering and paving costs.</i>					

## SERVICE LATERALS

Service laterals under streets extend from the wastewater main to the property lines. For estimating purposes, include a unit price for each property to be connected. Based on 2019 prices for 6-inch PVC and cleanouts, connection costs are estimated as follows:

- Service lateral in paved streets: \$3,000 to \$3,500
- Service lateral in new development areas or unpaved gravel streets: approximately \$4,000

## WASTEWATER PUMP STATIONS

Pump station structures generally are designed to handle ultimate peak flows. Pumps may be installed incrementally as required by development and population growth.

Cost estimates shown are for construction costs only, not including engineering, administration, or contingency. The pump station cost estimates shown should be used only for preliminary estimates. These tables were prepared by using actual bid prices, as shown in Table 6-3, for nine pump stations constructed in Eugene and Springfield since 1992.

<i>Table 6-3: Pump Station Costs from Recent Eugene/Springfield Projects</i>				
<b>Construction Year</b>	<b>Description of Project/Location</b>	<b>TDH</b>	<b>Firm Station Capacity</b>	<b>Low Bid Price <sup>1</sup></b>
2004	Airport Pump Station	100 ft.	0.6 MGD	\$1.192 M
1999	Barger/Greenhill Pump Station	160 ft.	3.6 MGD	\$3.877 M
1997	Crimson Pump Station	49 ft.	2.1 MGD	\$0.683 M
1994	Glenwood Pump Station <sup>2</sup>	30 ft.	18.0 MGD	\$3.935 M
2008	Harlow Road Pump Station <sup>2</sup>	51 ft.	10.0 MGD	\$4.771 M
1997	Lynnbrook Pump Station	27 ft.	0.29 MGD	\$0.196 M
2001	North Santa Clara Pump Station	48 ft.	0.60 MGD	\$0.501 M
2001	Oakway Pump Station	32 ft.	3.01 MGD	\$1.431 M
1997	Prairie Road Pump Station	106 ft.	3.30 MGD	\$1.174 M
<sup>1</sup> Adjusted to 2019 ENR 11281, excludes engineering				
<sup>2</sup> Station located in Springfield.				

This data was supplemented with the price of 16 other pump stations built by consultants or the City of Salem. All costs were adjusted to ENR Cost Index of 11281. The resultant table 6-4 is derived from a linear fit of all 25 pump stations. Pump station cost estimates can be made either from the table or from the linear fit equation:  $COST = 348674 * Q[MGD] + 547499$ . A more accurate estimate should be made when actual design information becomes available.

<i>Table 6-4: Estimated Construction Cost of Wastewater Pump Stations</i>	
<b>Pump Station Capacity (MGD)</b>	<b>Estimated Construction Cost <sup>1</sup></b>
0.3	\$652,000
0.5	\$722,000
1.0	\$896,000
2.0	\$1,245,000
3.0	\$1,594,000
4.0	\$1,942,000
5.0	\$2,291,000
7.0	\$2,988,000
10.0	\$4,034,000
12.0	\$4,732,000
15.0	\$5,778,000
20.0	\$7,521,000
<sup>1</sup> ENR = 11281	

## WASTEWATER PRESSURE LINES

Estimated construction costs for wastewater pressure lines are shown in Table 6-5. These costs were developed by updating the ENR index from the 1992 Master Plan to the 2019 index of 11281 and reviewing and comparing the values with recently bid projects. Costs are shown for two construction conditions: 1) in paved street areas, which require imported granular backfill material and pavement removal and restoration; and 2) in open areas, where surface restoration and utility conflicts are a minimum.

Both conditions assume minimum trench depth with three feet of cover above the top of pipe. The types of pipe material assumed for the various sizes are:

<b>Pipe Size/Range</b>	<b>Type of Pipe Material</b>
6-inch to 27-inch	PVC
30-inch and larger	Concrete-encased steel

<i>Table 6-5: Estimated Construction Cost for Wastewater Pressure Lines (Force Mains)</i>		
<b>Pipe diameter (inches)</b>	<b>Estimated construction cost (per foot)</b>	
	<b><i>In paved areas<sup>2</sup></i></b>	<b><i>In open areas<sup>1</sup></i></b>
6	\$66	\$43
8	\$76	\$53
10	\$93	\$65
12	\$108	\$75
14	\$156	\$114
16	\$169	\$125
28	\$255	\$194
30	\$271	\$210
36	\$417	\$341
42	\$507	\$425
72	\$899	\$786
<p><i>Notes: ENR =11281</i></p> <p><sup>1</sup> <i>Costs assume 3-foot depth of pipe cover, with imported granular backfill above the pipe zone area and minimal surface restoration or utility conflicts.</i></p> <p><sup>2</sup> <i>Costs assume 3-foot depth of pipe cover, with imported granular backfill above the pipe zone area and removal and restoration of pavement in trench area.</i></p>		

## ADDITIONAL INFORMATION

The estimated construction costs included here are for high-level planning purposes. All construction costs are influenced by the economy, time of bidding, difficulties of the specific project, and time allowed for construction. Consideration of all factors should be included when preparing project-specific estimates.

## Chapter 7 - Major Collection System Expansion

### PURPOSE

The purpose of this chapter is to summarize major wastewater collection system expansion in predominantly undeveloped areas within the Urban Growth Boundary.

### GENERAL COST INFORMATION

Cost estimates and a general service plan have been prepared for wastewater lines 10 inches and greater in diameter, pump stations, force mains, and 8-inch wastewater lines necessary to serve a pump station. In addition, Maps 7-B through 7-I indicate possible locations of 8-inch wastewater lines, but only for demonstrating the ability to serve all areas of the basin. In all cases, the plan is only one option for providing service. Based on development patterns, alternatives can be prepared that vary from this plan, provided that no plans are approved that cannot ultimately serve the entire basin.

Project cost estimates are based on preliminary design information and an *Engineering News Record* Construction Cost Index of 11281, which is the average index for 2019. An additional 35 percent has been added for engineering and administration costs. Contingency or escalation factors are not included.

Funding for these projects can happen in several ways. If the project is driven by a development, the developer would pay for the improvements and may receive SDC credits for constructing pump stations with capacity beyond that needed by the immediate development. They may also receive SDC credits for constructing wastewater lines greater than 8 inches in diameter.

If the City initiates a project, a portion of the cost would be assessed to adjacent property owners and other benefitted lot owners. The balance would be funded by SDCs.

Because SDCs and assessment funds have strict protocols on their use, additional funds may be needed for major system expansion projects to cover items such as:

- City costs related to petition or development projects
- Manhole cover replacement
- Deferred assessments
- Improvement to existing facilities
- Correction of system problems outside the rehab program

*Table 7-1: Summary of Costs for Proposed Capital Improvements to Wastewater System  
(Estimated Costs from Tables 7-2 Through 7-5)*

<b>Improvement Area Description</b>	<b>Total New Capacity Costs<sup>1</sup></b>
<b>1. SW – West 11<sup>th</sup>/Crow Road (Map 7-B)</b>	
a. 16672 to B-01	\$621,315
b. B-02 to B-01	\$559,396
c. B-03 to B-01	\$628,600
<b>2. SW – Willow Creek/West 18<sup>th</sup> (Map 7-C)</b>	
a. C-04 to 4348	\$401,957
<b>3. SW – Bailey Hill/Gimpl Hill (Map 7-D)</b>	
a. PS-D-55, PS-D-55 to D-05, and D-05 to 2324	\$1,550,044
<b>4. SI – North of East Enid Road (Map 7-E)</b>	
a. PS-E-06, E-07 to PS-E-06, and E-08 to PS-E-06	\$3,432,392
b. E-09 to E-08 and E-11 to E-08	\$1,033,029
c. E-16 to PS-E-12 and PS-E-12	\$3,006,912
<b>5. SI – South of East Enid Road (Map 7-E)</b>	
a. E-19 to 5706	\$526,109
<b>6. SI – South of Beltline Highway (Map 7-F)</b>	
a. F-21 to 15929	\$361,903
<b>7. WN – North Delta Highway (Map 7-G)</b>	
a. PS-G-22 and PS-G-22 to G-25	\$1,004,431
b. G-25 to 16814	\$207,341
<b>8. WN – Coburg Road/County Farm (Map 7-H)</b>	
a. PS-H-26 and PS-H-26 to 17007	\$1,014,379
b. PS-H-27 and PS-H-27 to 17015	\$1,168,176
<b>9. SI/BN – Clear Lake Road (Map 7-I)</b>	
a. I-30 to PS-I-32, I-33 to PS-I-32, and PS-I-32	\$5,457,149
b. I-39 to I-34	\$1,778,486
c. I-37 to I-39 and I-40 to I-39	\$1,047,655
d. I-41 to 5927, I-42 to W Irwin PS, W Irwin PS, and I-43 to 13369	\$2,420,126
<b>Total</b>	<b>\$26,219,399</b>
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and administration	

## PRELIMINARY DESIGN AND COST ESTIMATED BY AREA

The major wastewater collection system improvements which may impact the City of Eugene Capital Improvement Program in the next 20 years are in the following areas (see Map 7-A for an overview):

### ***South West Eugene (SW)***

The South West Basin flows north to the Bethel Basin and is serviced by the Terry Street and Barger pump stations. Future development within this basin should not trigger major pump station upgrades.

The South West Eugene Basin has three distinct areas for wastewater development:

- West 11<sup>th</sup>/Crow
- Willow Creek/18<sup>th</sup> Avenue
- Bailey Hill/Gimpl Hill Roads

The West 11<sup>th</sup>/Crow area has approximately 370 acres of underdeveloped or undeveloped land. The current service plan for this area, shown on Map 7-B, does not vary drastically from the 1992 USSMP.

The Willow Creek/18<sup>th</sup> Avenue area, shown on Map 7-C, has approximately 230 acres of underdeveloped or undeveloped land. Due to the extensive protected wetlands in this sub-basin, the only wastewater line greater than 10 inches is planned to extend down Willow Creek Road approximately 1800 feet.

The Bailey Hill/Gimpl Hill Road area is approximately 155 acres of underdeveloped or undeveloped land. The 1992 Master Plan indicated that a gravity wastewater line be constructed north from Gimpl Hill Road, and then west down 18<sup>th</sup> to Willow Creek Road. Since that plan, all of the land between Gimpl Hill Road and 18<sup>th</sup> has been identified as protected wetlands. Constructing this wastewater line would be cost prohibitive due to the environmental impacts of constructing in the wetlands. The master plan for this area, as shown on Map 7-D, includes a new pump station, located along Gimpl Hill Road. A pressure main would pump the wastewater to the top of Bailey Hill Road, and allow flow by gravity to the existing system. Preliminary analysis indicates that the pipe running north to 18<sup>th</sup> Avenue has capacity for this change from the 1992 plan. Other than these improvements, no wastewater lines greater than 10 inches are required in this basin.

### ***Highway 99 Industrial Area (SI)***

With the exception of the Prairie Road pump station and the gravity wastewater line extending to the north, most of the improvements indicated in the 1992 USSMP have yet to be built. Map 7-E and Map 7-F show the updated service plan, which still includes two new pump stations. The northernmost pump station (PS-SI2) and the associated force main and gravity lines serve a single lot, currently owned by MWMC. The costs of these improvements would not be eligible for SDC credits.

### ***Willakenzie Area (WN)***

The Willakenzie North area is bounded on the west by the Willamette River, on the east by Interstate Highway 5, and on the south by Beltline Highway. There are two main undeveloped areas: North Delta Highway, and the County Farm/Coburg area.

The North Delta Highway area has approximately 156 acres that is not currently developed. The service plan for this area is shown on Map 7-G. Generally, the area would drain to the Crimson Pump Station, which was built in 1997 and designed for this loading. The furthest northwest corner on the basin would require either extensive fill, or the construction of an additional pump station, which was not identified in the 1992 USSMP. In addition, the pump station and associated force main and gravity lines would only serve this lot and therefore are not eligible for SDC credits.

The County Farm/Coburg area has many underdeveloped or undeveloped parcels. Wastewater service for this area was originally designed in the 1992 Wastewater Master Plan. Much of those improvements

have been constructed, and Map 7-H indicates future needs. As planned in 1992, two new pump stations will be required to fully service this basin.

#### ***Clear Lake Road (SI/BN)***

In 2017, the Clear Lake Expansion added 924 acres of land to Eugene’s Urban Growth Boundary near Clear Lake Road. This expansion will add sub-basins to Basins SI and BN.

The service plan for this area is on map 7-I. As much land as cover will allow will be drained south into pipes that lead to the West Irwin Pump Station. The remainder of the lots will be drained North into Enid Pump Station, which will need to be relocated and upsized.

<i>Table 7-2: Proposed Wastewater Capital Improvements for South West Eugene</i>							
<b>Location</b>	<b>Preliminary Design Information</b>						
<b>Manhole Basin/No.</b>	<b>Capacity (CFS)</b>	<b>Pipe Size (Inches)</b>	<b>Invert Elevation</b>	<b>Slope (Ft./ft.)</b>	<b>Length (Ft.)</b>	<b>Average Depth (Ft.)</b>	<b>Estimated Cost<sup>1</sup></b>
<b>SW - West 11<sup>th</sup>/Crow Road (Map 7-B)</b>							
From 16672 To B-01	3.76	15	379.7 383.3	0.002	1570	23	\$621,310 <sup>2</sup>
From B-01 To B-02	1.42	10	383.3 387.5	0.0025	1540	21	\$559,400 <sup>2</sup>
From B-01 To B-03	1.42	10	383.3 388.8	0.0025	2015	17	\$625,560 <sup>2</sup>
<b>SW - Willow Creek/West 18<sup>th</sup> (Map 7-C)</b>							
From C-04 To 4348	2.70	10	389.7 406.7	0.009	1830	10	\$390,940 <sup>2</sup>
<b>SW - Bailey Hill / Gimpl Hill (Map 7-D)</b>							
PS-SW1	0.8 MGD		430	N/A	N/A	10	\$910,570
From PS-SW1 To D-05		6" force main	430 496.0	N/A	1450	3	\$129,910
From 2324 To D-05	2.43	8	437.9 496.0	0.024	2400	8	\$505,980 <sup>2</sup>
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and administration							
<sup>2</sup> Assumed to be constructed in existing roads.							



Table 7-3: Proposed Wastewater Capital Improvements for Hwy 99 Industrial Basin (North)

Location	Preliminary Design Information						
Manhole Basin/No.	Capacity (CFS)	Pipe Size (Inches)	Invert Elevation	Slope (Ft./ft.)	Length (Ft.)	Average Depth (Ft.)	Est. Const. Cost <sup>1</sup>
<b>SI - North of East Enid Road (Map 7-E)</b>							
PS-E-06 (lift station located at the end of Action Way)	4.8MGD		351.9	N/A	N/A	21	\$2,731,720
From PS-E-06 To 16103	7.48	18	367.5 367.0	0.003	150	6	\$34,910
From PS-E-06 To E-07	1.56	10	351.9 355.2	0.003	1000	17	\$255,420
From PS-E-06 To E-08	6.11	18	351.9 354.5	0.002	1175	19	\$398,220
From E-08 To E-09	1.42	10	354.5 359.1	0.0025	1650	16	\$421,440
From E-08 To E-10	6.11	18	354.5 357.2	0.002	1200	15	\$346,320
From E-10 To E-11	4.60	15	357.2 361.1	0.003	1200	10	\$217,930
PS-E-12 (lift station located north of Awbrey Lane)	2.9MGD		345			19	\$1,669,390
From PS-E-12 To E-11		12" force main	345 361.1	N/A	2360	4	\$239,940
From PS-E-12 To E-13	1.56	10	345 350.4	0.003	1640	14	\$353,450
From PS-E-12 To E-14	3.76	15	345 347.3	0.002	1000	17	\$270,290
From E-14 To E-15	2.07	12	347.3 350.0	0.002	1200	13	\$265,280
From E-15 To E-16	1.42	10	350.0 352.2	0.0025	800	9	\$139,320
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and administration							

*Table 7-4: Proposed Wastewater Capital Improvements for Hwy 99 Industrial Area Basin (South)*

<b>Location</b>	<b>Preliminary Design Information</b>						
<b>Manhole Basin/No.</b>	<b>Capacity (CFS)</b>	<b>Pipe Size (Inches)</b>	<b>Invert Elevation</b>	<b>Slope (Ft./ft.)</b>	<b>Length (Ft.)</b>	<b>Average Depth (Ft.)</b>	<b>Est. Const. Cost<sup>1</sup></b>
<b>SI - South of East Enid Road (Map 7-E)</b>							
From 5706 To E-17	4.2	15	363.5 365.7	0.0025	800	10	\$145,240
From E-17 To E-18	2.32	12	365.7 368.9	0.0025	1100	10	\$191,830
From E-18 To E-19	1.42	10	368.9 371.1	0.0025	800	10	\$139,320
<b>SI - South of Beltline Highway (Map 7-F)</b>							
From 15929 To F-20	2.32	12	371.2 373.4	0.0025	800	16	\$259,820 <sup>2</sup>
From F-20 To F-21	1.42	10	373.4 374.5	0.0025	400	15	\$105,020 <sup>2</sup>
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and administration							
<sup>2</sup> Assumed to be constructed in existing roads.							

Table 7-5: Proposed Wastewater Capital Improvements for Willakenzie Area



Location	Preliminary Design Information						
Manhole Basin/No.	Capacity (CFS)	Pipe Size (Inches)	Invert Elevation	Slope (Ft./ft.)	Length (Ft.)	Average Depth (Ft.)	Est. Const. Cost <sup>1</sup>
<b>WN - North Delta Highway (Map 7-G)</b>							
PS-G-22 (in the northwest corner of the basin)	0.3MGD		380	N/A	N/A	8	\$758,810
From PS-G-22 To G-23		6" Force Main	383 396.1	N/A	580	4	\$33,450
From G-23 To G-24	1.0	8 3	396.1 393.1	0.004	680	5	\$74,360
From G-24 To G-25	1.0	8 <sup>3</sup>	389.9	0.004	750	10	\$131,430
From G-25 To 16814	1.27	10	389.9 388.0	0.002	775	17	\$197,900
<b>WN - Coburg Road/County Farm (Map 7-H)</b>							
PS-H-26	0.4MGD		396	N/A	N/A	18	\$910,570
From PS-H-26 To 17007		6" Force Main	N/A	N/A	1,160	4	\$103,810 <sup>2</sup>
PS-H-27	0.3MGD		404	N/A	N/A	11	\$758,810
From PS-H-27 To H-28		6" Force Main	N/A	N/A	1,300	4	\$74,970
From H-28 To 17015	1.0	8 3	414.4 407.7	0.004	1575	7	\$332,060 <sup>2</sup>
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and administration							
<sup>2</sup> Assumed to be constructed in existing roads.							
<sup>3</sup> 8-inch lines required for the pump station							

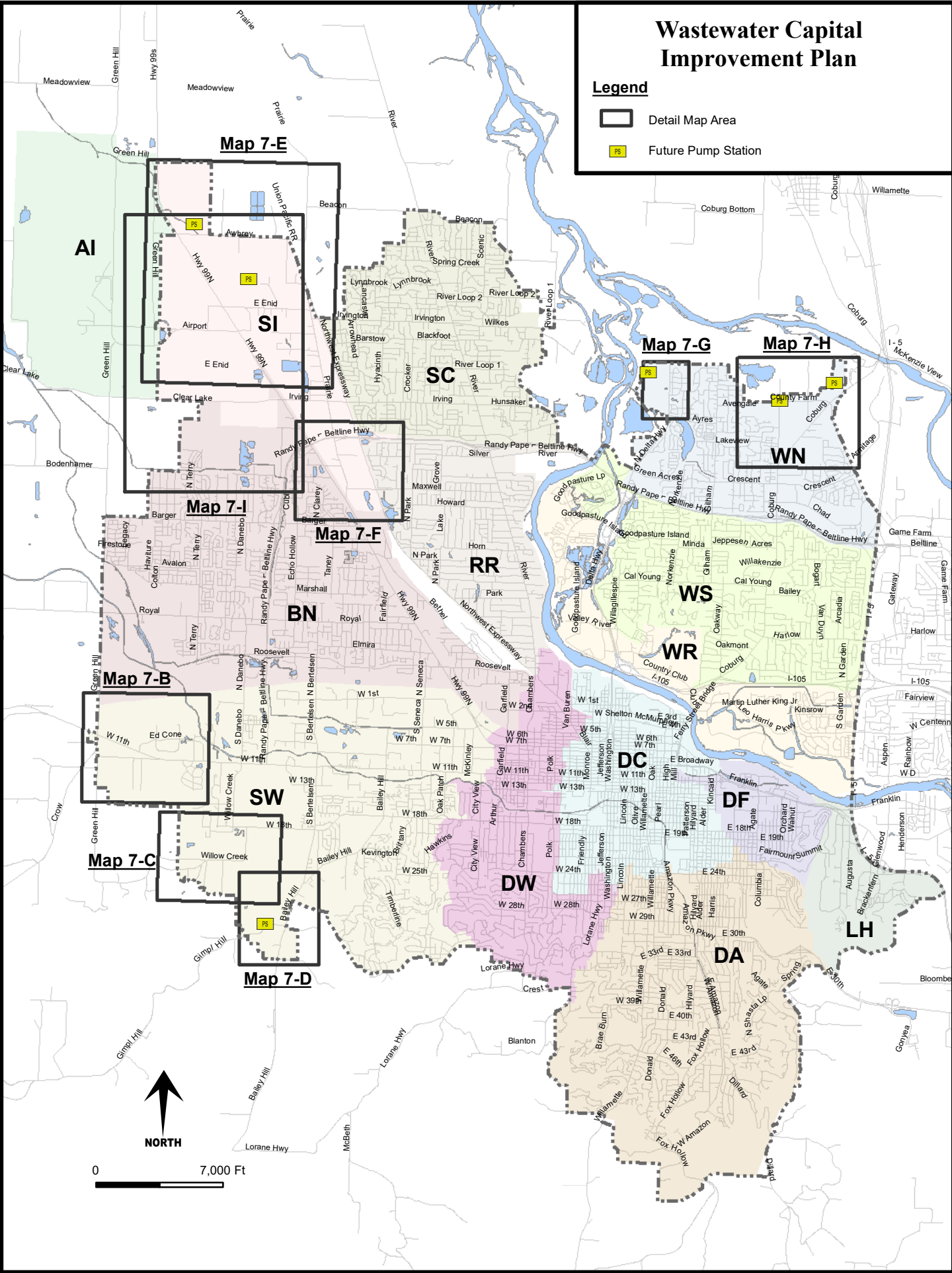
Table 7-6: Proposed Wastewater Capital Improvements for Clear Lake Area

Location	Preliminary Design Information						
Manhole Basin/No.	Capacity (CFS)	Pipe Size (Inches)	Invert Elevation	Slope (Ft./ft.)	Length (Ft.)	Average Depth (Ft.)	Est. Const. Cost <sup>1</sup>
<b>North Delta Highway (see Map 7-I)</b>							
PS-I-30	5.5 MGD (new capacity)		342.7	N/A	N/A	31	\$3,336,500
From I-30 To I-31	2.54	12	351.6 347.6	0.003	1318	21	\$420,250
From I-31 To PS-I-32	2.54	12	347.6 343.5	0.003	1380	26	\$511,910 <sup>2</sup>
From I-34 To PS-I-32	6.26	18	345.5 342.7	0.0021	1325	31	\$642,550 <sup>2</sup>
From I-33 To I-34	1.56	10	354.4 349.9	0.003	1503	23	\$545,930 <sup>2</sup>
From I-35 To I-34	5.11	15	350.7 345.5	0.0037	1401	29	\$554,430 <sup>2</sup>
From I-36 To I-35	5.11	15	359.3 350.7	0.0037	2515	24	\$845,890
From I-39 To I-36	3.36	15	362.0 359.3	0.0016	1297	18	\$378,180
From I-37 To I-38	1.21	10	367.0 365.5	0.0018	800	9	\$175,720 <sup>2</sup>
From I-38 To I-39	1.91	12	365.5 362.0	0.0017	1999	13	\$551,220 <sup>2</sup>
From I-40 To I-39	1.42	10	368.6 365.4	0.0025	1200	12	\$320,700 <sup>2</sup>
From I-41 To 5927	1.10	10	364.1 363.0	0.0015	714	13	\$162,540
From I-42 To W Irwin PS	1.42	10	355.3 355.1	0.0025	64	26	\$23,250 <sup>2</sup>
From I-43 To 13369	1.27	10	361.9 360.0	0.004	464	21	\$145,680
<sup>1</sup> All costs shown are in 2019 dollars and include 35% for engineering and contingency <sup>2</sup> Assumed to be constructed in existing roads.							

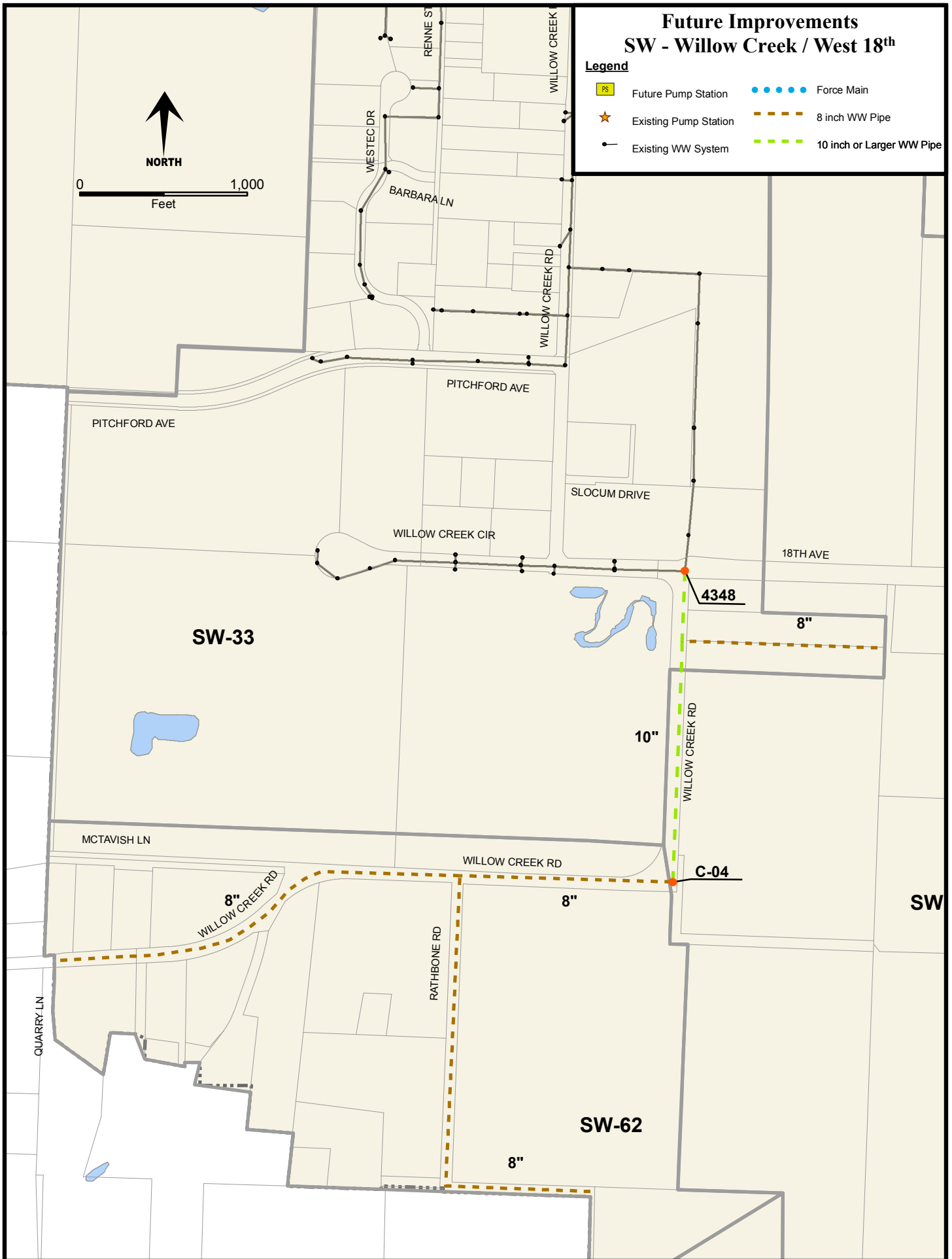
# Wastewater Capital Improvement Plan

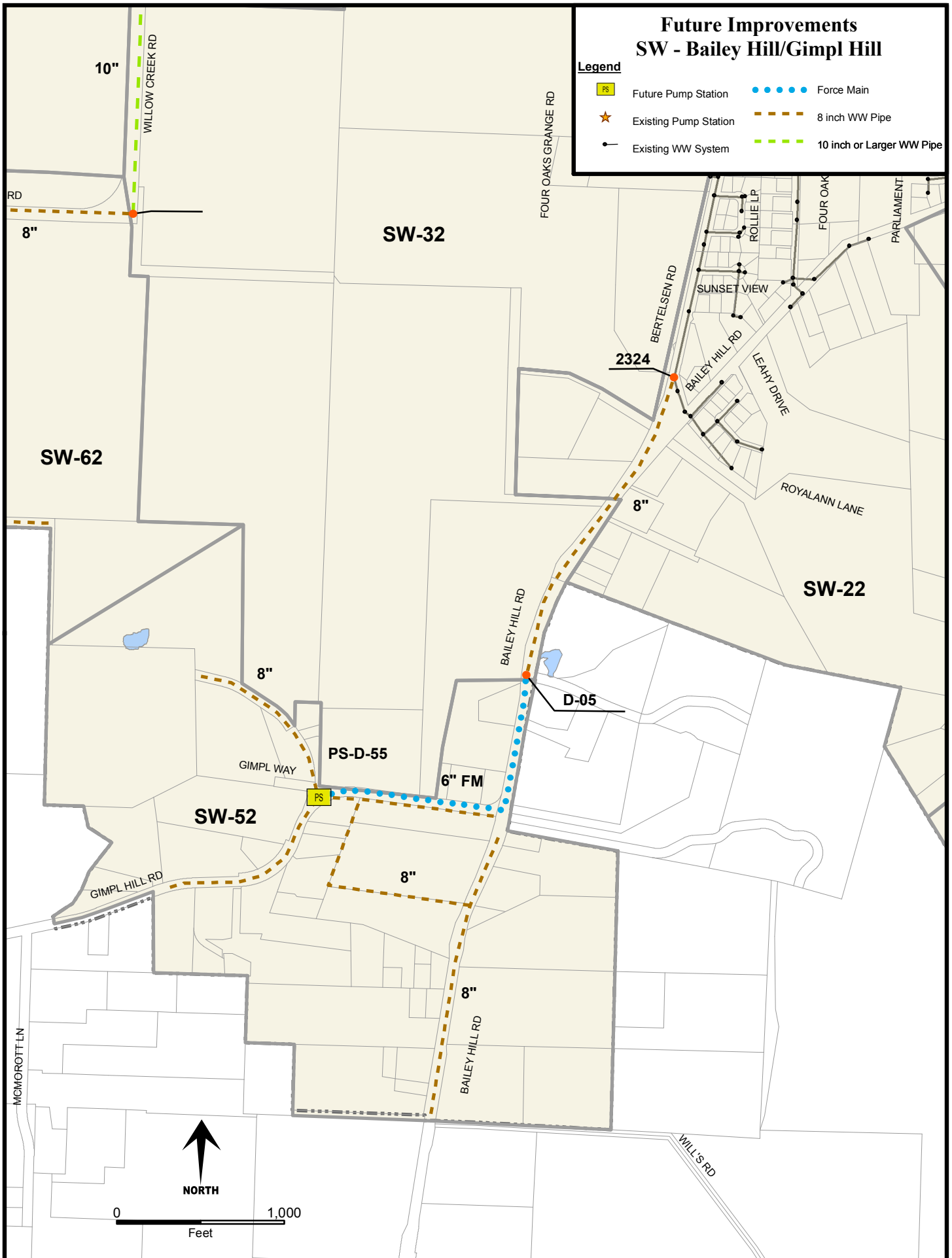
## Legend

-  Detail Map Area
-  Future Pump Station

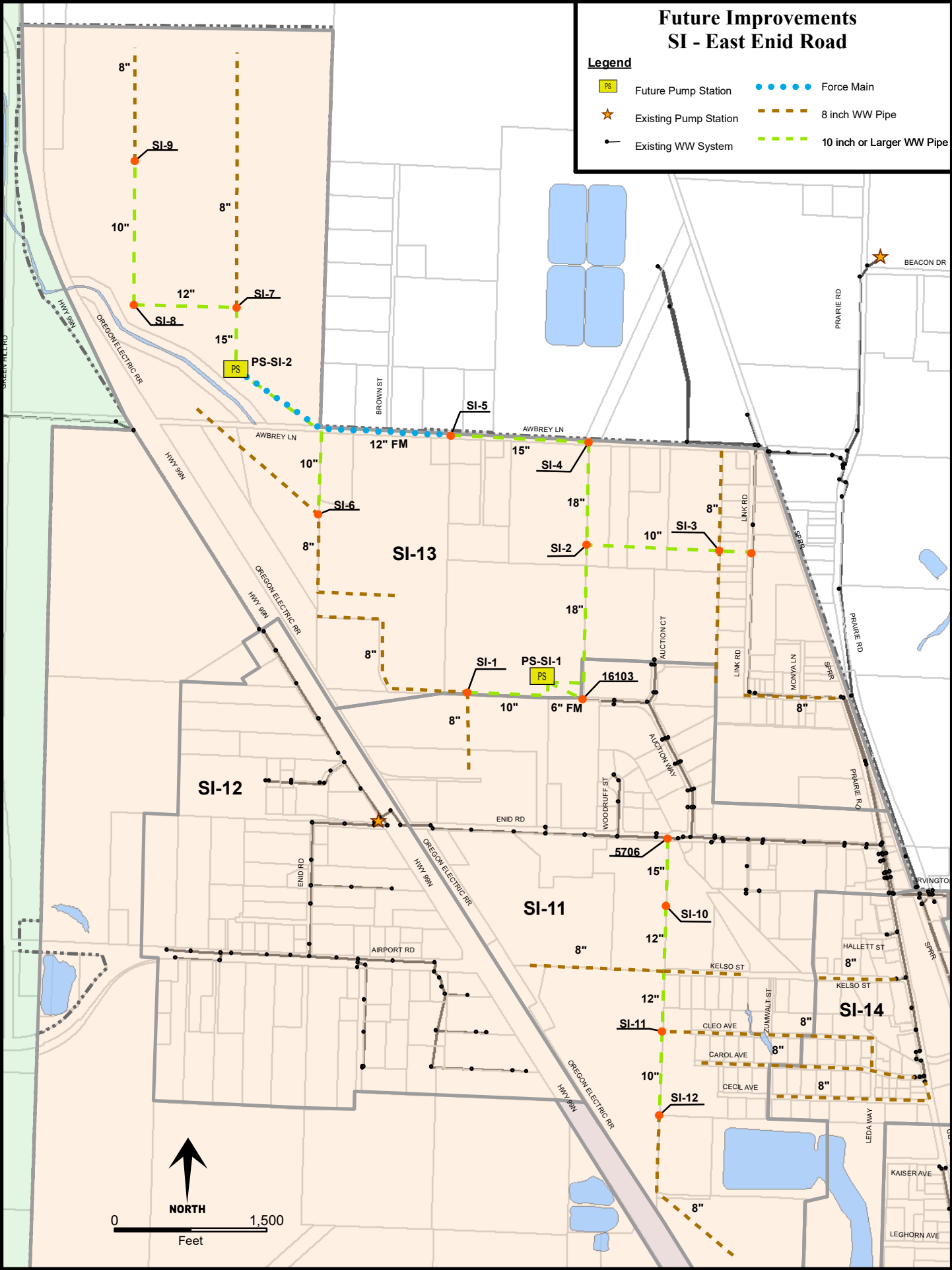


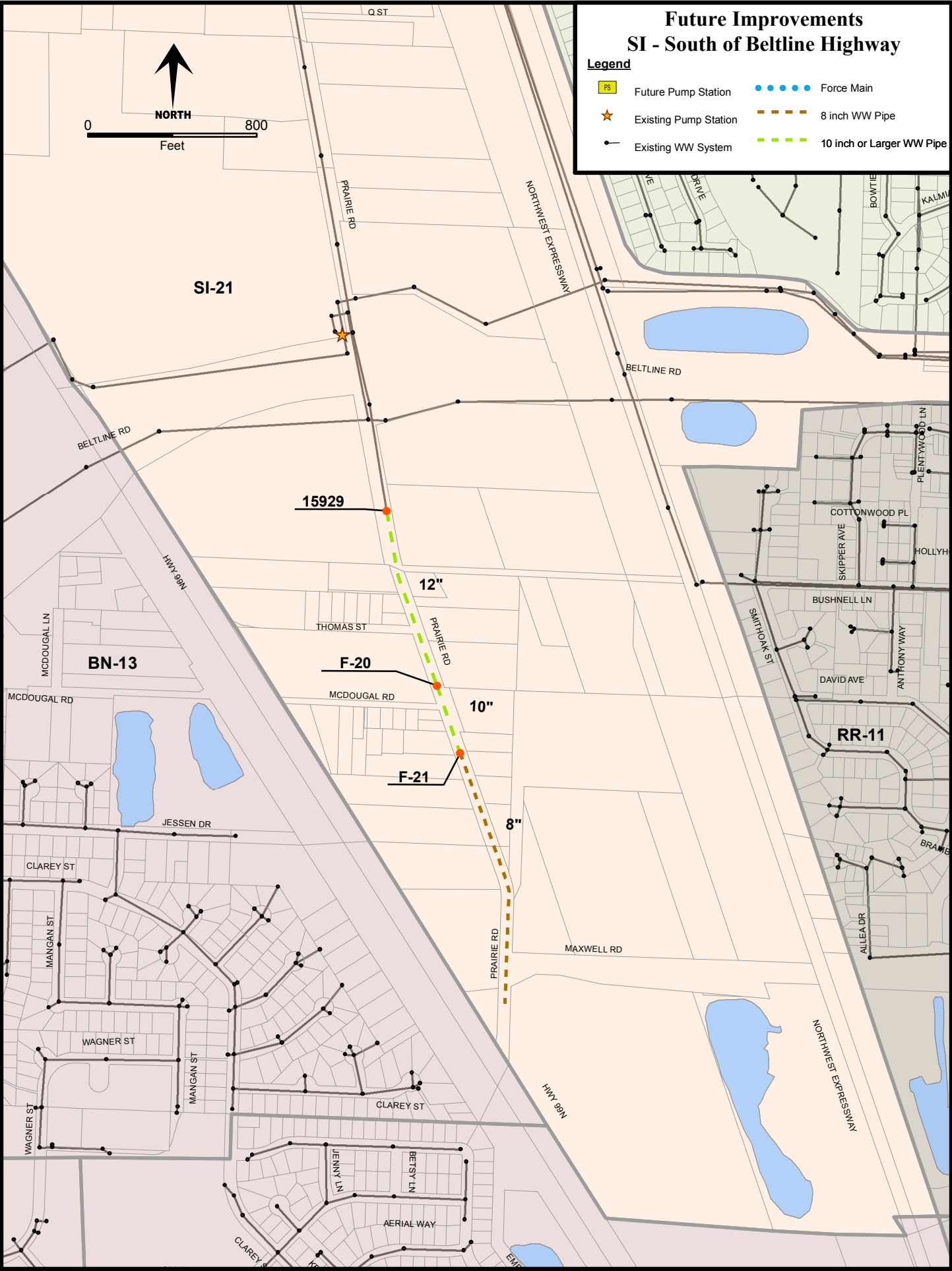


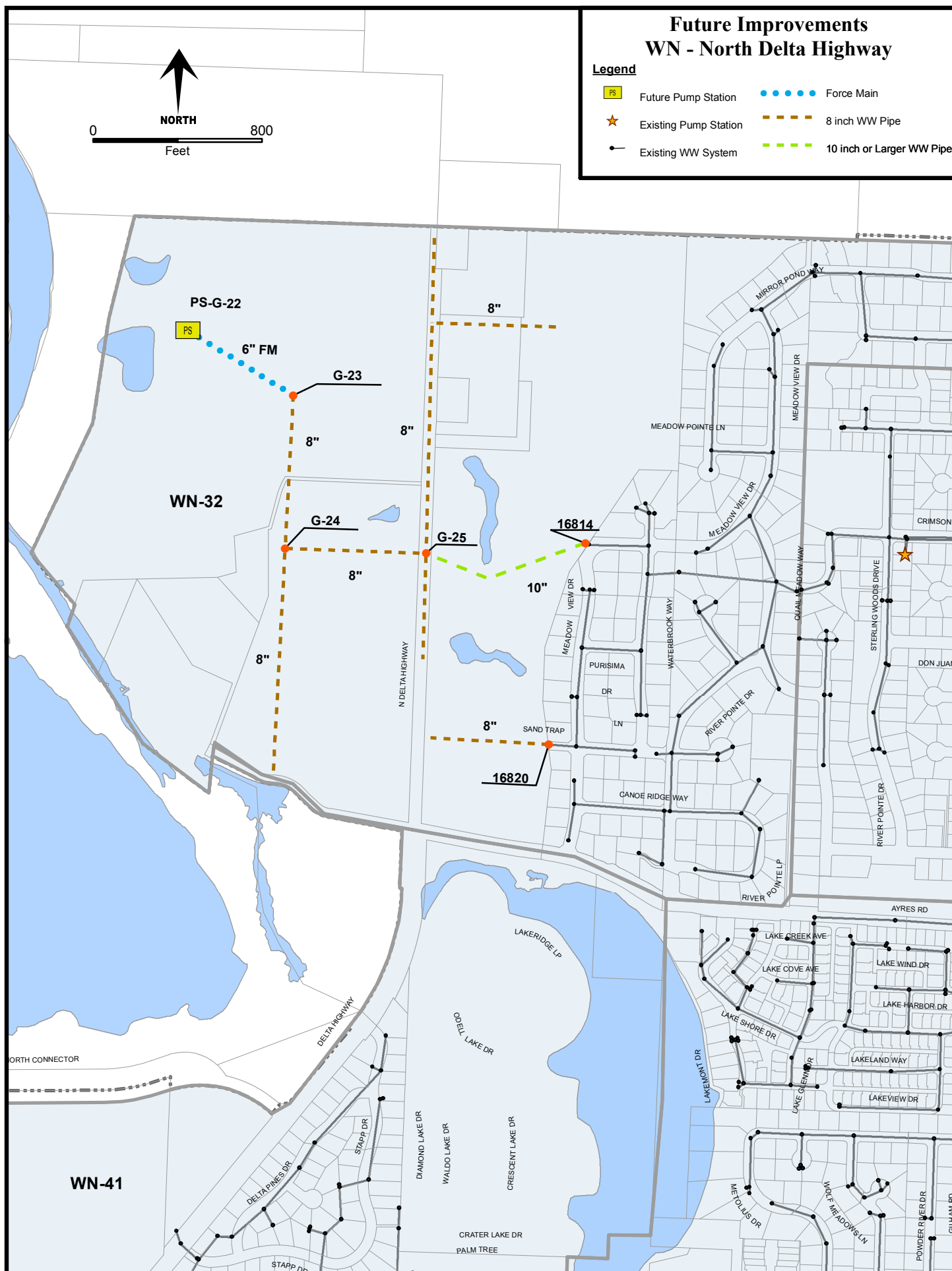








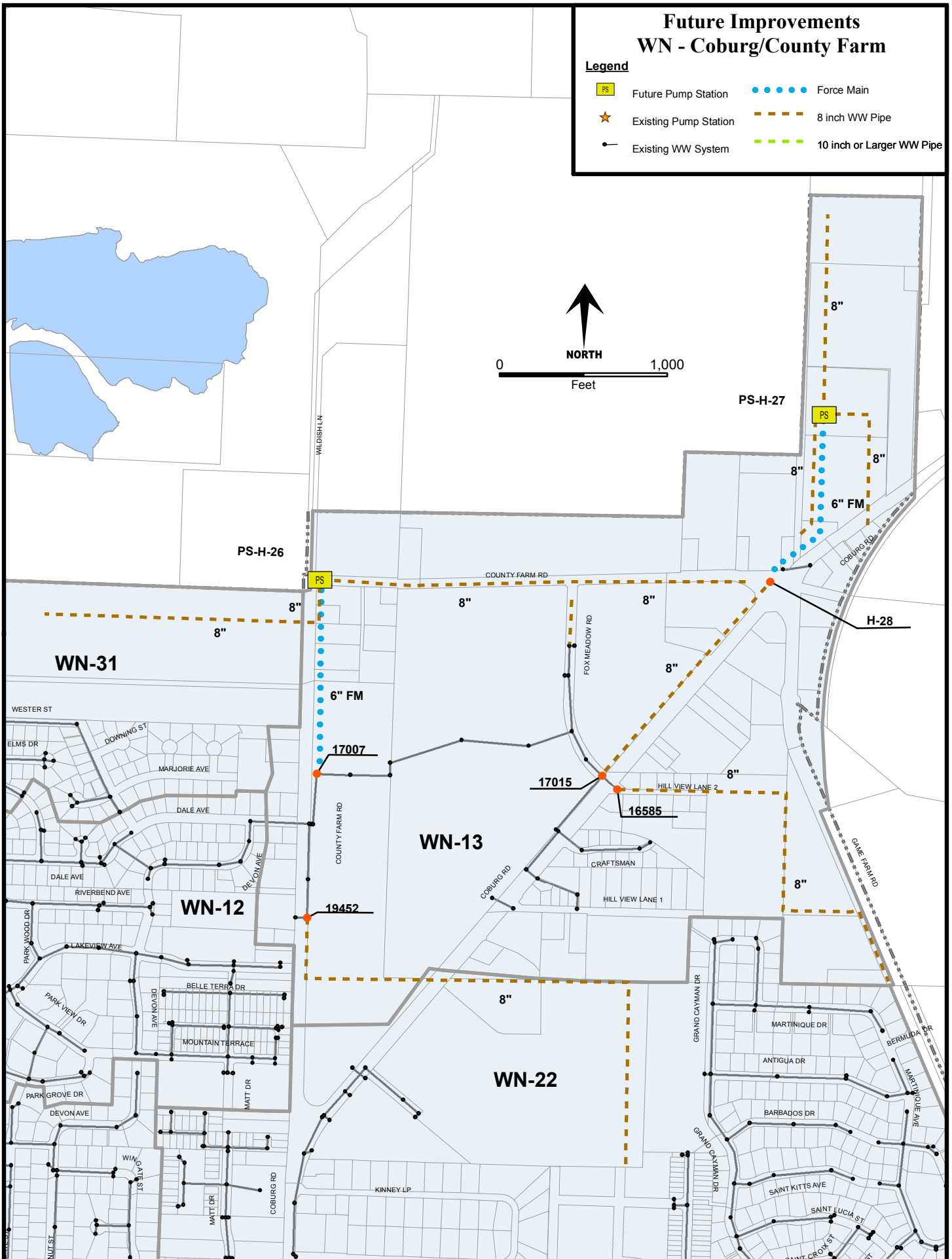
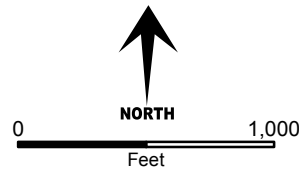


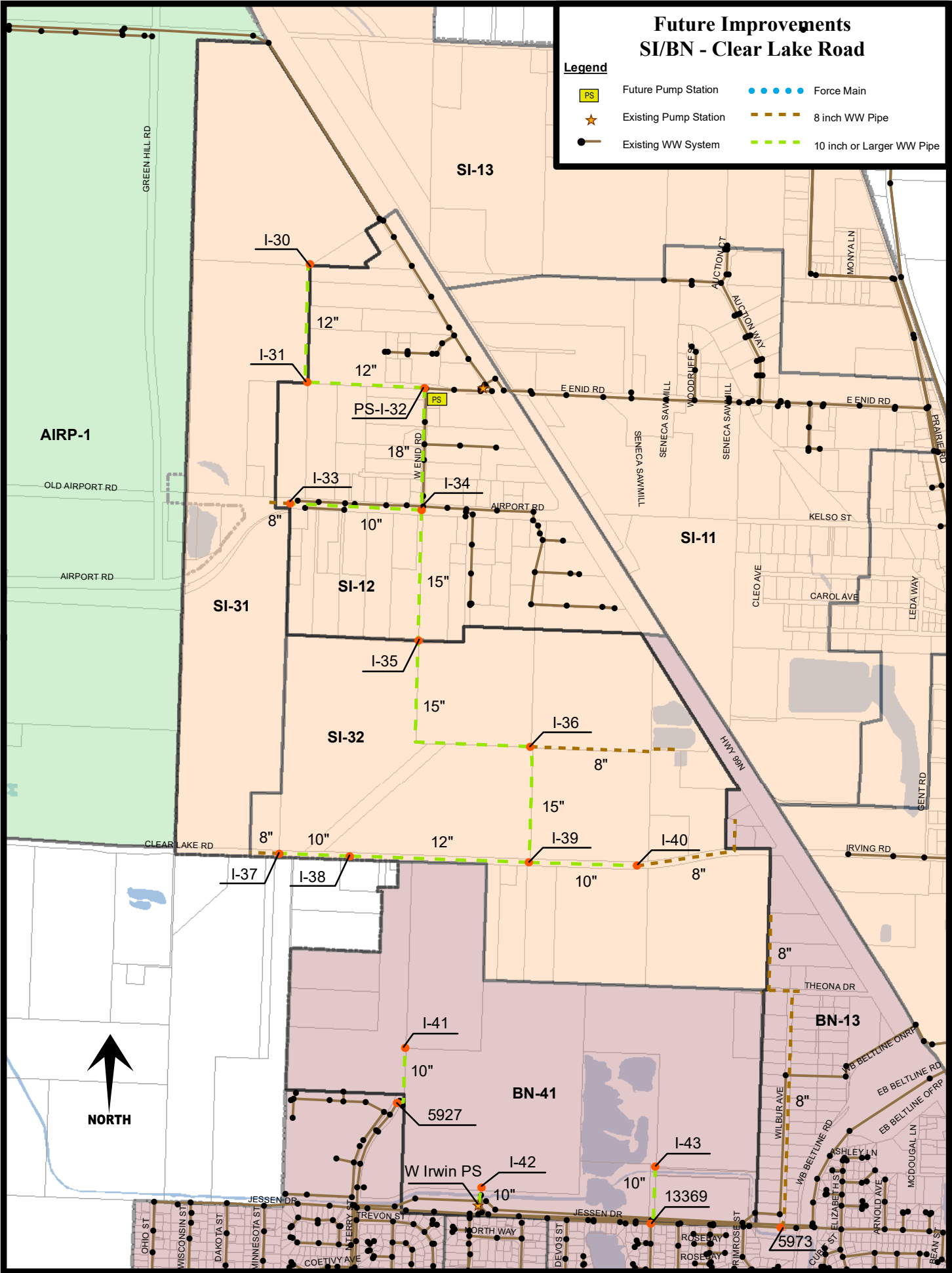


## Future Improvements WN - Coburg/County Farm

### Legend

- PS Future Pump Station
- ★ Existing Pump Station
- Existing WW System
- Force Main
- 8 inch WW Pipe
- 10 inch or Larger WW Pipe





## **Glossary and Key to Abbreviations**

ACP – asphaltic concrete pavement

ADWF – average dry-weather flow, used to calculate system flows, including base flow and peak flow

CFS – cubic feet per second

CIP – capital improvement plan, used to plan long-term major infrastructure improvements

CIPP – cured-in-place pipe, a treatment used to repair wastewater lines

DEQ – Oregon Department of Environmental Quality

DU – dwelling unit

ENR – Engineering News-Record, a weekly publication that publishes an extensive amount of data on building material prices and construction labor costs

Force main – a wastewater pipe that conveys wastewater under pressure

GAD – gallons per acre per day

GPM – gallons per minute

Gravity line – a wastewater pipe that conveys wastewater by gravity

I/I – inflow and infiltration. Inflow occurs when stormwater enters the wastewater system through inappropriate connections such as downspouts. Infiltration occurs when groundwater enters the wastewater system through cracks and other deficiencies in wastewater collection pipes.

Interceptor – a large-diameter wastewater pipe that conveys large volumes of wastewater

Kgal – 1,000 gallons

Metropolitan Area General Plan – the overarching planning document for land within the EugeneSpringfield urban growth boundary.

MGD – thousands of gallons per day, used to quantify the volume of wastewater flows

MWMC – Metropolitan Wastewater Management Commission, a governmental agency comprised of representatives from Lane County and the cities of Eugene and Springfield to manage regional wastewater services in the metro area. The City of Eugene operates the regional collection and treatment system, and Springfield provides administrative services for the regional agency.

PFF – peak flow factor

PGD - permanent ground deformation

Pump station – a wastewater facility, also known as a lift station, that pressurizes and pumps wastewater when gravity is not sufficient to convey the flow

SDC – system development charges, impact fees generally collected when expansion, new development, or an intensification of use occurs on property served by City infrastructure. The fees are used to fund

the non-assessable portion of infrastructure construction costs needed to support growth in the community and to recoup a portion of the community's investment in the infrastructure already in place

UGB – urban growth boundary, a boundary established under state planning law to regulate urban development

USSMP - the City of Eugene's 1992 Urban Sanitary Sewer Master Plan

### FINAL Technical Memorandum

**Date:** June 30, 2016

**From:** Donald Ballantyne, PE

**To:** Teri Higgins, City of Eugene

**Subject:** Seismic Assessment of Wastewater Collection and Conveyance System

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#### 1. Introduction

This Technical Memorandum describes the seismic assessment conducted by Ballantyne Consulting, LLC of the City of Eugene, Oregon (Eugene) sewage collection and conveyance system. The work was done as a subconsultant to West-Yost. Eugene staff provided GIS support. Eugene provides collection and conveyance of wastewater but does not provide treatment. The system consists of about 3.65 million feet of sewer pipe ranging in size from eight- to seventy-two-inches in diameter. This planning level assessment evaluated the expected performance of these sewers. There are 26 wastewater pump stations in the system. This assessment evaluated five of the older more typical pump stations.

The assessment evaluated the expected performance of a moment magnitude 9.0 ( $M_w9.0$ ) Cascadia Subduction Zone (CSZ) earthquake on the system. Earthquake ground motion, liquefaction and landslide probabilities and permanent ground deformations (PGD) were obtained from the Oregon Department of Geology and Mineral Industries (DOGAMI), using the planning level earthquake hazard data that was developed for the Oregon Resilience Plan.

It is the intent that the findings of this evaluation be incorporated into the Eugene Wastewater Comprehensive Plan.

#### 2. Regional Seismicity and the Cascadia Subduction Zone Earthquake

The CSZ is the most significant earthquake source zone that can impact Eugene. A CSZ event is expected to have similar impacts as the 2011 Japanese Tohoku Earthquake. The postulated  $M_w9.0$  CSZ fault runs about 600 miles from mid-Vancouver Island in Canada south to Eureka California. Starting at one end, it would take about 5 minutes for it to “un-zip”, resulting in ground shaking for that duration along its length. The CSZ fault zone is located off the Pacific coast shore line, on-the-order of 100 miles distant from Eugene, so strong shaking has attenuated by the time it reaches the City. The CSZ has traditionally been considered to have a 500-year recurrence interval with an event breaking its entire length with a magnitude on the order of  $M_w9.0$ . The last event occurred in 1,700 AD. Multiple smaller events would also be possible breaking adjacent segments of the fault.

In recent years, Dr. Chris Goldfinger, at Oregon State University, has studied turbidites along the CSZ and concluded that there is a shorter recurrence interval in southern segment of the CSZ. In the segment



from approximately Yaquina Bay south to Coos Bay (i.e. due west from Eugene), he proposes a recurrence interval of 300 to 380 years. If that is the case, it is expected that some of these events to be smaller than a M9.0 expected on the average of every 500 years.

For the CSZ M<sub>w</sub>9.0 event, the Eugene area would expect peak ground accelerations (PGA) on the order of 15 to 20 percent times gravity, or about 7 in/sec peak ground velocity (PGV is another shaking intensity parameter used for pipeline evaluation). By comparison, events such as the 1994 Northridge, California Earthquake and the 1995 Kobe, Japan Earthquake produced PGAs on the order of 60 to 80 percent times gravity. The recent Napa, California Earthquake produced a PGA on the order of 50 percent times gravity.

The CSZ information included on the DOGAMI Open File Report 13-06 (O-13-06), and used to develop the Oregon Resilience Plan, addresses this event. Hazard mapping from O-13-06 used for this evaluation included:

- Peak Ground Velocity (PGV)
- Liquefaction Probability
- Permanent Ground Deformation (PGD) Due to Liquefaction
- Earthquake Induced Landslide Probability
- Permanent Ground Deformation (PGD) Due to Landslides

Earthquakes cause shaking that can result in structural damage to facilities and buried piping. They can also cause liquefaction and associated lateral spreading, and landslides, both of which are forms of PGD. PGD is particularly damaging to buried piping. In the 1995 Kobe Earthquake, wide-spread liquefaction and associated ground deformation was the primary cause of over 1,200 pipeline failures. In the 2011 Christchurch New Zealand earthquake, widespread liquefaction along the Avon River caused extensive damage to both water and sewer pipelines.

DOGAMI mapping shows a low probability of liquefaction (0-5%) along the Willamette and McKenzie Rivers. The probability is low for several reasons. First, the higher liquefaction susceptibility found further north along the Willamette River in Oregon was due to alluvial deposits in the backwater of the Missoula Floods. That flood backwater did not extend south as far as Eugene. Second, the alluvial deposits found along the two rivers in the Eugene area are generally too coarse to allow liquefaction, as the rivers are just starting to lose energy coming out of the Cascades. Finer sands are washed downstream. The mapping shows the most significant liquefaction probability (moderate, 5 – 15% probability as defined by DOGAMI) in Eugene in the hills in the southwestern, southern, and southeastern areas of the City. This liquefiable material is likely from other local sources. DOGAMI maps the moderate liquefaction probability soils overlapping with areas mapped as having high landslide susceptibility. The probabilities are taken into account when estimating the number of pipeline failures.

DOGAMI maps also provided an estimate of the PGD expected in a CSZ event. Once the ground liquefies, or a landslide is initiated, the ground will permanently displace, moving downhill, or towards a free face such as a river bank. The greater the PGD, the more pipeline damage is expected.

### **3. Overview of Seismic Vulnerability of Wastewater Systems**

Wastewater systems are vulnerable to earthquakes due to shaking and ground deformation. Structures such as pump stations, above grade piping, and treatment plants are vulnerable to seismic lateral loading. Heavy, cast in place reinforced concrete structures that make up many wastewater system components are resistant to lateral loading. Other types of structures such as tilt-up buildings, concrete frame buildings, and unreinforced masonry buildings are vulnerable.

The building code to which structures were designed is important. In Oregon, the Zone designation in the Uniform Building Code (UBC) that was in place in the early 1990s, was increased from Zone 2 to Zone 3 as seismologists gained a better understanding of regional seismicity. Buildings designed earlier are more vulnerable to earthquakes. Buildings designed to modern earthquake codes should perform much better in a CSZ event.

When the building shakes, inadequately supported piping and conduits can swing and break off at hard points, wall penetrations and connections to pumps and other equipment. Heavy inline equipment such as check valves add additional loading to the pipelines exacerbating the situation. Steel and ductile pipe will perform better than brittle cast iron. Broken pipelines can result in flooding particularly in below grade structures.

Regional power is often disrupted. High voltage substation equipment is the most seismically vulnerable part of a power system with their tall fragile ceramic insulators. Substation rigid busses and switch gear is also fragile. Within facilities, inadequately anchored electrical cabinets can tip over, breaking off connections and damaging internal equipment.

In addition to shaking, liquefaction and associated lateral spreading can be devastating to the wastewater facilities. Wastewater facilities are often sited in low areas where it is likely to be more liquefiable. The Higashinada Treatment Plant in Kobe Japan was founded on liquefiable soil. In the 1995 Kobe Earthquake, the plant site settled up to one meter and moved laterally two meters causing extreme damage. If liquefaction occurs below or around a building such as a pump station, it can float or tip severing connecting pipelines as occurred to several pump stations in the 2011 Christchurch New Zealand event. Even if everything within the pump station remains intact, the sewage cannot flow in or get pumped out. In some cases, the opening left from these severed pipe connections allowed liquefied sand to enter the pump station. Cleanup of liquefied sand in wastewater pump stations was an issue in Seattle following the 2001 Nisqually Earthquake.

Pipelines are potentially more vulnerable than structures. Ground shaking can cause adjacent pipe segments to move relative to one another damaging rigid joints. Joints that are mortared can crack.

While it may not result in catastrophic failure, infiltration can increase. When liquefaction occurs gravity pipelines can float changing its grade line. A high point in the sewer can result in solids deposition and reduction in flow capacity. In the 1965 Seattle Earthquake, a large diameter sewer under the Cedar River floated upwards about two feet. Floatation can also result in opening up pipe joints allowing entry of liquefied sand. Sand removal was a huge issue in Christchurch when they were trying to restore operation.

Liquefaction related lateral spreading can be the most devastating. It can separate joints, and cause pipeline segments to physically break. The good news is that sewer pipeline catastrophic damage (e.g. where sewage can no longer flow) is much less likely than water pipeline damage. In the 1994 Northridge Earthquake in Los Angeles, approximately 1,000 water main failures occurred in the San Fernando Valley. In the same area, only 10 sewer collapses were reported where the Los Angeles Department of Public Works was required to hook up pumps and hoses to move sewage around a collapsed pipe section. Note however, that there was a very limited amount of liquefaction in the San Fernando Valley in that event. Ultimately, sewers in a significant part of the San Fernando Valley had to be replaced due to cracking of both pipe and joints.

#### **4. Evaluation of Wastewater Collection and Conveyance System**

This section addresses both evaluation of sewer pipelines and pump stations.

Hazard mapping available from DOWAMI was used for both pipelines and pump stations. For pipelines, the shaking intensity data in the form of peak ground velocity (PGV) was used, estimated to be 7 inches/second for the CSZ event across the City. The PGV was used as input into a pipe fragility equation developed by the American Lifelines Alliance (ALA) as follows:

##### ***Shaking Repair Rate (ALA)***

$$\text{Repair Rate/1,000'} = K \times 0.00187 \times \text{PGV}$$

Where:

K = a constant used representing different pipe materials. For this project the K values shown in Table 1 were used:

**Table 1. Pipe K Values for Various Pipe Materials**

Pipe Material	K
Concrete - assumed bell & spigot	0.7
PVC/Truss	0.7
Continuously Lined between Manholes - Various Host Pipes, includes HDPE	0.4
Transite (asbestos cement)	0.5
Cast Iron/Steel	1.0
Clay	1.0

PGV = peak ground velocity in in/sec; 7 in/sec used for CSZ earthquake

Generally, the same K values used for water pipelines were used except values for clay pipe and lined pipe which were not included in the ALA document. Clay pipe was assumed to have about the same performance as cast iron. It is somewhat more brittle, but has more joints, possibly making it more flexible. Pipeline lining (such as resin impregnated polyester fabric) has been lab tested in gas pipelines at Cornell University for earthquake performance. The material adheres to the pipe wall when pressurized such as in water systems. For gravity sewers, it may slide inside the pipe which would improve its performance. A K value of 0.4 was selected for this polyester liner, better than modern bell and spigot pipe, but not as good as HDPE as the liner would minimize the effect of joint cracking.

***Permanent Ground Deformation Repair Rate (ALA)***

$$\text{Repair Rate/1,000'} = K \times 1.06 \times \text{PGD}^{0.319}$$

The same K values are used as shown above for pipe subjected to PGD.

PGD in inches is included DOGAMI mapping.

Pipe types, and PGD zones were mapped using GIS, and the above equation applied to the various categories. Eugene GIS staff did the pipe material take off for the various hazard zones. The total lengths of pipe for various materials and diameters are shown in Table 2.

**Table 2. Eugene Sewer Pipe Lengths (in feet) by Material and Diameter (inches)**

	8" or less	10"-12"	15"-20"	21"-30"	36"-48"	54"-72"	
Concrete - assumed bell & spigot	1,196,312	154,417	125,096	128,049	81,383	37,904	
PVC/Truss	1,391,462	82,639	25,834	8,575			
Continuously Lined between Manholes - Various Host Pipes, includes HDPE	302,756	54,595	17,979	4,935	1,016		
Transite	9,365	6,575	3,772				
Cast Iron/Steel	2,268	499	176	125	21		
Clay	12,464	686	175				
						<b>Total</b>	<b>3,649,078</b>

Table 3 shows the expected number of repairs when the sewer system is subjected to wave propagation (shaking). This is not a precise number with a range in the results of minus 50% to plus 100%. Repairs for areas subjected to liquefaction are not included in this table. The large majority of the repairs are in small diameter concrete and PVC/Truss pipe, driven by the large footage in these categories. These repairs would be randomly distributed across the system.

**Table 3. Expected Gravity Pipe Repairs Due to Wave Propagation (PGV)**

Pipe Type	K	8" or less	10"-12"	15"-20"	21"-30"	36"-48"	54"-72"	Total
Concrete - assumed bell & spigot	0.7	10	1	1	1	1	0	14
PVC/Truss	0.7	11	1	0	0	0	0	12
Continuously Lined between Manholes - Various Host Pipes, includes HDPE	0.4	2	0	0	0	0	0	2
Transite	0.5	0	0	0	0	0	0	0
Cast Iron/Steel	1.0	0	0	0	0	0	0	0
Clay	1.0	0	0	0	0	0	0	0
<b>Total</b>		23	2	1	1	1	0	<b>29</b>

Table 4 shows the expected number of repairs when the system under goes the expected permanent ground deformation estimated by DOGAMI. This is not a precise number with a range in the results of minus 50% to plus 100%. The large majority of the failures are in small diameter concrete and PVC/Truss pipe. Many of these repairs are found in the areas with high probability of liquefaction and PGDs in the hills in the southern part of Eugene.

**Table 4. Expected Gravity Pipe Failure Due to Liquefaction/Lateral Spread (PGD)**

	K	8" or less	10"-12"	15"-20"	21"-30"	36"-48"	54"-72"	Total
Concrete - assumed bell & spigot	0.7	26	3	2	2	2	0	34
PVC/Truss	0.7	26	1	0	0	0	0	28
Continuously Lined between Manholes - Various Host Pipes, includes HDPE	0.4	2	0	0	0	0	0	3
Transite	0.5	0	0	0	0	0	0	0
Cast Iron/Steel	1.0	0	0	0	0	0	0	0
Clay	1.0	0	0	0	0	0	0	0
<b>Total</b>		54	5	2	2	2	0	<b>65</b>

For pressure pipe, there is a very limited length, so the expected number of failures is two or less.

The ALA (for water pipeline fragilities) includes a relationship between leaks and breaks; for PGV related repairs, 20% are estimated to be breaks, and 80% leaks. For PGD related repairs, 80% are estimated to be breaks and 20% leaks. For sewers, it is assumed leaks will result in increased infiltration. Breaks would be related to catastrophic pipe collapse. Applying these relationships, the results are shown in Table 5.

**Table 5. Estimated Number of Pipeline Repairs and Catastrophic Failures**

Failure Categories	Calculated Leaks	Calculated Breaks	Calculated Total	Estimated Catastrophic Repairs
PGV Related Repairs	23	6	29	1
PGD <= 4" Related Repairs	8	31	39	8
PGD > 4" Related Repairs (1)	5	21	26	21 (1)
Total Calculated Repairs	36	58	94	30

(1) Repairs in areas with PGDs > 4 in pipe 12" and smaller, located in the southern Eugene hills.

Sewer pipe is inherently weaker than water pipe, and types and extent of failures are expect to be different. Failures requiring immediate attention, e.g., collapses have a lower rate than water main failures which include both leaks and breaks. Assume 25 percent of the total calculated repairs are catastrophic failures (i.e., where the sewer no longer transports sewage) where PGDs are 4 inches or less, or in any of the pipe subjected only to PGV. Where the PGD is greater than 4 inches, most of the failures are in pipelines 12-inches in diameter and smaller, and are expected to be located in the hills along the southern side of the City.

As there is so little pressure main footage, calculations showed only one or two failures are likely. However, if differential settlement occurs at the 3 pump stations in liquefiable soil, that number could increase.

## 5. Evaluation Expected Performance of Wastewater Pump Stations

Five of Eugene's 26 wastewater pump stations were selected as being representative of older pump stations in the system (Table 6). These pump stations were evaluated by observation, site visits to each, discussions with staff, and review of the available facility drawings. Liquefaction probability was taken from DOGAMI mapping.

**Table 6. Representative Older Wastewater Pump Stations that were Evaluated (sorted by capacity)**

Name	Date of Construction	Type	Structure	Capacity (MGD)	Liquefaction Probability (3)	Emergency Operation
Fillmore	1960, Upgrade 1996	Submersible	Below grade, Wet Well A - 2 Submersibles, Wet Well B - 3 Submersibles, Control Room below grade above Wet Well A	44	Low (0-5%)	Generator Transfer Switch, Pump Around Available
West Irwin	1984 with seismic, pump/ pipe upgrade	Wet well/ Dry well	Wet Well/ Dry Well Caisson: Brick/ steel superstructure	21	None	Onsite generator, two power sources
Terry Street	1984	Wet well/ Dry well	Wet Well/Dry Well Caisson, Wood frame superstructure	14	None	Two power sources
Tadmore	1978	Submersible	2 pumps in MH with attached Control Vault	8	Low (0-5%)	Pump Around Available
Division Avenue	1984, 2007 Upgrade	Submersible	2 pumps in MH with attached Control Vault	1	Low (0-5%)	Pump Around Available

Three potential general vulnerabilities for Eugene pump stations include: 1) power interruption, 2) electrical and control cabinet toppling, and 3) site liquefaction. The general status of items 1) and 3) are shown on Table 6. Regional power interruption is likely. High voltage substations transporting power into the region are vulnerable. Power systems have failed following many earthquakes around the world, and would be expected in a CSZ event. As the entire region could well be without power, two power sources would not improve the power reliability.

Electrical power and control cabinets are vulnerable to toppling if they are not properly anchored. During the site visits, observations inside the cabinets were not made.

Three of the pump stations are in low liquefaction zones (0-5% probability). If the liquefaction occurred, the pump station manhole/vault could float damaging both inlet and outlet connecting piping. Pipe is ductile iron so significant differential movement would be required to cause it to fail. A better understanding of the City geotechnical seismic environment should be developed, and critical facilities addressed accordingly.

Focused discussions about each pump station that was evaluated follow.

#### ***Fillmore Pump Station***

Manhole and vault structures and piping appear adequate to resist seismic loading. Submersible pumps anchorage dependent of manufacturer's design. Historically these have not failed in earthquakes

#### ***West Irwin***

The pump station caisson is divided into wet- and dry wells with a reinforced concrete wall separation. The pump station superstructure corners overhang the caisson; it is unclear whether they are cantilevered or on small foundations. If they are supported on foundations, differential settlement could damage the building. The brick superstructure was retrofitted with a steel frame between wall sections and supporting the roof trusses. No retrofit design drawings were available. The superstructure should be evaluated by a structural engineer. The brick walls are rigid and the steel frame is ductile. When subjected to 2 – 3 minutes of shaking, the bricks could fall away leaving no lateral support for the remaining steel columns that support the roof

Pump discharge lines and the discharge header lateral support appear to be inadequately braced, and should be checked by a structural engineer.

In the event the pump station fails, it is designed to overflow to Terry St Pump Station, so pump station failure may not be catastrophic.



### ***Terry Street***

The pump station caisson is divided into wet- and dry wells with a reinforced concrete wall separation. The pump station superstructure corners overhang the caisson; it is unclear whether they are cantilevered or on small foundations. If they are supported on foundations, differential settlement could damage the building.

The pump station wood frame superstructure beam and roof connections should be evaluated. The pump station was designed prior to the seismic rezoning in the 1990s. Wood frame structures with large openings are vulnerable if connections are inadequately detailed.

Pump discharge lines and the discharge header lateral support appear to be inadequately braced and should be checked by a structural engineer.

### ***Tadmore***

The pump station pipe material is unknown. If 1968 vintage piping could be cast iron, which is brittle and vulnerable in earthquakes. Manhole and vault structures and piping appear adequate to resist seismic loading. Submersible pumps anchorage dependent of manufacturer's design. Historically these have not failed in earthquakes. This design is older than the others and as a result is more vulnerable to failure. Check with the pump station manufacturer on the stability of the pump anchorage.

### ***Division Avenue***

Manhole and vault structures and piping appear adequate to resist seismic loading. Submersible pumps anchorage dependent of manufacturer's design. Historically these have not failed in earthquakes

## **6. Mitigation Recommendations for Collection/ Conveyance Sewers and Pump Stations**

This section recommends action items to minimize the impact of a CSZ Earthquake on the Eugene wastewater system.

1. Geotechnical Hazard Parameters - Develop a better understanding of the probabilities and PGDs associated with liquefaction and landslide within the City. Pipeline performance in earthquake is controlled by the geotechnical hazard environment. The DOGAMI maps used for this project designated liquefiable areas along the Willamette River as having a low probability of liquefaction occurring (5 percent or less), and if it did liquefy, PGDs would be 4-inches or less. The DOGAMI maps showed pockets of moderate liquefaction in southern Eugene, some areas with the probability of liquefaction being as high as 15 percent with PGDs as high as 40 inches. In the same areas the landslide probabilities are as high as 30 percent with PGDs exceeding 100 inches. These geotechnical earthquake hazard parameters strongly influence the expected performance of the sewer system.

## 2. Existing Sewers

- a. Sewers in Non-Liquefiable Areas. Pipe joints may crack due to shaking. Pipeline collapse will be limited. Continue to slip-line sewers if required for other reasons. It will reduce the potential for cracking and infiltration following an earthquake.
- b. Sewers in Low Probability Liquefiable Areas (0 – 5% probability and PGDs of 4-inches or less). These areas are found along the Willamette River. If liquefaction occurs, there will be some pipeline damage, although the probability is small. For critical (large diameter pipes 24-inches and larger) pipelines that are difficult to access for repair (e.g. river crossings), consider slip lining them to hold the pipe segments together. Products such as those available from Insituform (polyester liner) should be adequate, although the lining material has limited ductility. HDPE slip lining would be preferred as it is much more ductile.
- c. Sewers in Moderate Probability Liquefiable Areas (5 - 15% probability and PGDs greater than 4 inches. These same areas are subject to landslides with a 15 – 30% probability of occurrence and with PGDs potentially exceeding 100 inches. These areas are found in the hills in southern Eugene. These pipelines are typically 12-inches diameter or less serving small areas. It is difficult to mitigate these sewers if large PGDs occur. Slip lining the system with HDPE would have the greatest likelihood of success, but even that may be limited. Make sure that damaged sewers can overflow to the River without backing up buildings or overflowing into the streets.

## 3. New Sewers

- a. Sewers in Non-liquefiable areas. Use pipe with joints that can accommodate small differential movements (less than  $\frac{1}{2}$ " ) without cracking. Standard bell and spigot pipe with rubber gaskets is acceptable. Pipe materials can include concrete, vitrified clay, and PVC.
- b. Critical Sewers (24-inch and larger) in Low Probability Liquefiable Areas (0 – 5% probability and PGDs of 4-inches or less). These areas are found along the Willamette River. Design the pipe to be neutrally buoyant so if the surrounding soil liquefies, it won't float. Use specially designed pipe with double depth bells to limit joint pull-out of segmented pipe. HDPE, reinforced concrete, steel, or ductile iron pipe is required. For difficult to access locations (e.g. river crossings) use continuous or restrained joint pipe such as HDPE, steel with welded joints, or ductile iron with restrained joints.
- c. Non-Critical Sewers (less than 24-inch diameter) - Low Probability Liquefiable Areas (0 – 5% probability and PGDs of 4-inches or less). These areas are found along the Willamette River. It is preferred but not required to design the pipe to be neutrally

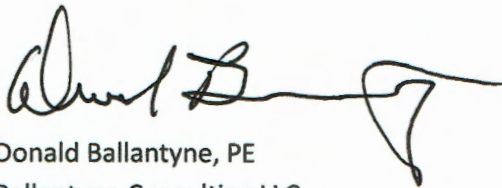
buoyant with specially designed double depth bells to limit pull out. HDPE, PVC, reinforced concrete, steel pipe, or ductile iron is required.

- d. Sewers in Moderate Probability Liquefiable Areas (5 - 15% probability and PGDs greater than 4 inches. These same areas are subject to landslides with a 15 – 30% probability of occurrence and with PGDs greater than 4 inches and potentially exceeding 100 inches. These areas are found in the hills in southern Eugene. These pipelines are typically 12-inches diameter or less serving small areas. Use continuous pipe such as HDPE, steel with welded joints, molecularly oriented PVC with restrained joints, or restrained ductile iron pipe. To maintain longitudinal continuity, design the pipe to pass through manholes.
- e. Pressure Sewers in Non-liquefiable areas. Use continuous pipe or segmented pipe with elastomeric gaskets.
- f. Pressure Sewers in Low Probability Liquefiable areas (0 – 5% probability and PGDs of 4-inches or less). These areas are found along the Willamette River. Use continuous pipe such as HDPE, steel with welded joints, molecularly oriented PVC with restrained joints, or restrained ductile iron pipe.
- g. Pressure Sewers in Moderate Probability Liquefiable areas (5 – 15% probability and PGDs exceeding 4-inches and potentially exceeding 100 inches). These areas are found in the hills in southern Eugene. Use continuous pipe such as HDPE, steel with welded joints, molecularly oriented PVC with restrained joints, or restrained ductile iron pipe, all with the ability to accommodate 1-percent strain.
- h. Repair Materials – Evaluate repair materials required for critical large diameter sewers. Acquire and stockpile materials accordingly.

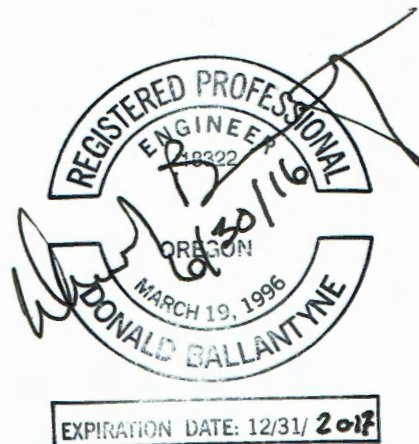
#### 4. Existing Pump Stations

- a. Emergency Overflows - Provide emergency overflows for all pump stations to protect public health. Design overflows so that sewage will not backup into buildings or overflow into City streets.
- b. Emergency Power - Provide capability for emergency power for all pump stations. It is likely that the regional power system will be inoperable so even pump stations with two feeds would be inoperable. Each pump station should have a built in emergency generator or a quick connect for an emergency generator. Develop an emergency generator plan to address the generators owned, generator rotation, and generator refueling.
- c. Cabinet Anchorage - Inspect all electrical and control cabinets in all pump stations to assure they are anchored to the floor, wall or ceiling above. Anchor those found to be deficient.

- d. Liquefaction – Identify all pump stations in liquefiable areas. Evaluate the foundations to determine whether liquefaction was taken into account. Develop a plan to mitigate pump station movement/flotation considering replacement or upgrade. Pump Stations Evaluated
- e. Fillmore – No recommendations
- f. West Irwin – Evaluate the pump station superstructure original design and seismic upgrade to assess its seismic vulnerability. Replace or mitigate accordingly. Evaluate the pump discharge lines and discharge header for lateral resistance.
- g. Terry Street – Evaluate the pump station wood superstructure seismic vulnerability. Evaluate the pump discharge lines and discharge header for lateral resistance.
- h. Tadmore – Check pump station pipe material. If it is cast iron (likely for the time it was constructed), evaluate pipe support, bracing and flexibility. Evaluate the submersible pump anchorage for seismic resistance, as this is a particularly old pump station.
- i. Division Ave – No recommendations



Donald Ballantyne, PE  
Ballantyne Consulting LLC





## Memorandum

Date: October 27, 2017  
To: File  
From: Teri Higgins  
Subject: Clarification/Update to Ballantyne Consulting Technical Memo

During the final review of the Wastewater Master Plan, it was discovered that the current HazVu map on the DOGAMI website indicates a significant amount of moderate liquefaction Hazard in the Eugene Area. A review of data used for the Ballantyne memo, and a discussion with Don Ballantyne revealed the following:

- The source used for the analysis was the DOGAMI Open File Report 13-06 (O-13-06), which is the file specific to the Cascadia M9 Event. This is the same source used to develop the Oregon Resilience Plan.
- The outline of the areas on the current HazVu map are identical to the outlines used for the technical memo.
- The current HazVu map indicates no areas of low probability of liquefaction, only None, Moderate, or High in the Eugene area.
- The attached map indicated the areas of low probability used for both the EWEB report and the Eugene report.

Don confirmed that DOGAMI modified the current HazVu and changed most of the Low Probability areas to Moderate. Although he is not exactly sure why they did that, he suspects they were trying to standardize liquefaction across the state.

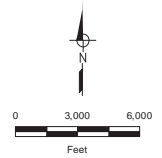
As stated in Don's technical memo, he does not believe that the lower valleys of Eugene are of a high enough probability for liquefaction to warrant concerns, and the need to change/upgrade construction standards of gravity wastewater pipe. The recommendations outlined on page 12 of the memo for areas of moderate probability should only be applied to areas in the hills of south Eugene.



**FIGURE 9**

**EWEB  
2014 Water Master Plan**

**RESILIENCY PLANNING -  
LIQUEFACTION  
PROBABILITY VS.  
CAST IRON PIPELINES**



Notes  
1. Source: Oregon\_Resilience\_Plan\_Ground\_Motion\_and\_Ground\_Failure\_Maps.gdb.

**LEGEND**

- Water Treatment Plant
- Raw Water Intake
- Active Pump Station
- Existing Reservoir

**Pipe Material**

- Other
- Cast Iron
- Hydrology Feature
- EWEB Service Area

**Probability of Liquefaction**

- Not Liquefiable
- Low (0-5%)
- Medium (5-15%)
- High (15-27%)

## Memorandum

Date: March 30, 2016  
To: File  
From: Teri Higgins, P.E.  
Subject: Validation of Industrial/Commercial Design Flow Rates

Unlike residential flow rates, commercial and industrial flow rates have an extreme range of values depending on the industry. The table on the following page shows the highest industrial users in Eugene & Springfield which clearly indicates the wide variation in flows.

An examination of multiple municipalities also indicated a wide range of design values and methodologies. Springfield, for example, has a short list of mostly commercial uses (motels, restaurants, nursing homes, etc.) and flow rates per person, bed, etc. There is essentially no guidance on industrial flows. This method of estimation assumes that one knows the exact industry that is up stream, and yet to be identified. Philomath and Albany assign values based on Land Use, similar to Eugene, but only have a couple of categories. Clean Water Services also assigns values based on Land Use, and has a more extensive list, similar to Eugene, but typically their values are significantly higher. A summary spreadsheet is included at the end of this memo.

In general, flow rates for commercial and industrial flows should be based on an assumed employment density and a flow per employee, *in addition to the process flow rate for the type of industry*. An EWEB graph attached indicates a relatively steady trend in water consumption for industrial and commercial users over a 20 year period.

The design values included in the 1992 Urban Sanitary Sewer Master Plan were established based on the 1961 Sewer Study Report prepared by CH2M Hill and utilized a per employment flow plus an estimated industry flow. Without further evidence to the contrary, the 1992 flow rates will be carried forward in the new Master Plan. In addition, 1 new category will be established to more directly correspond to land use designations (a complete description is included in the master plan):

- **Campus Industrial:** The target employment is 21 persons/acre. The Campus Industrial land use category could include industries that have a varying water demand, but also may have less dense development than other commercial/industrial uses. Utilizing the pure per capita rate of 67 gallons may grossly underestimate the flow rate. A more reasonable value similar to the Light-Medium Industrial rate of 3040 will provide a low cost factor of safety.

The flow rates listed for commercial and industrial uses are for upstream master planning purposes only, when no additional information is available as to proposed developments. Always consider other factors and use the best engineering judgement when assigning flow rates.

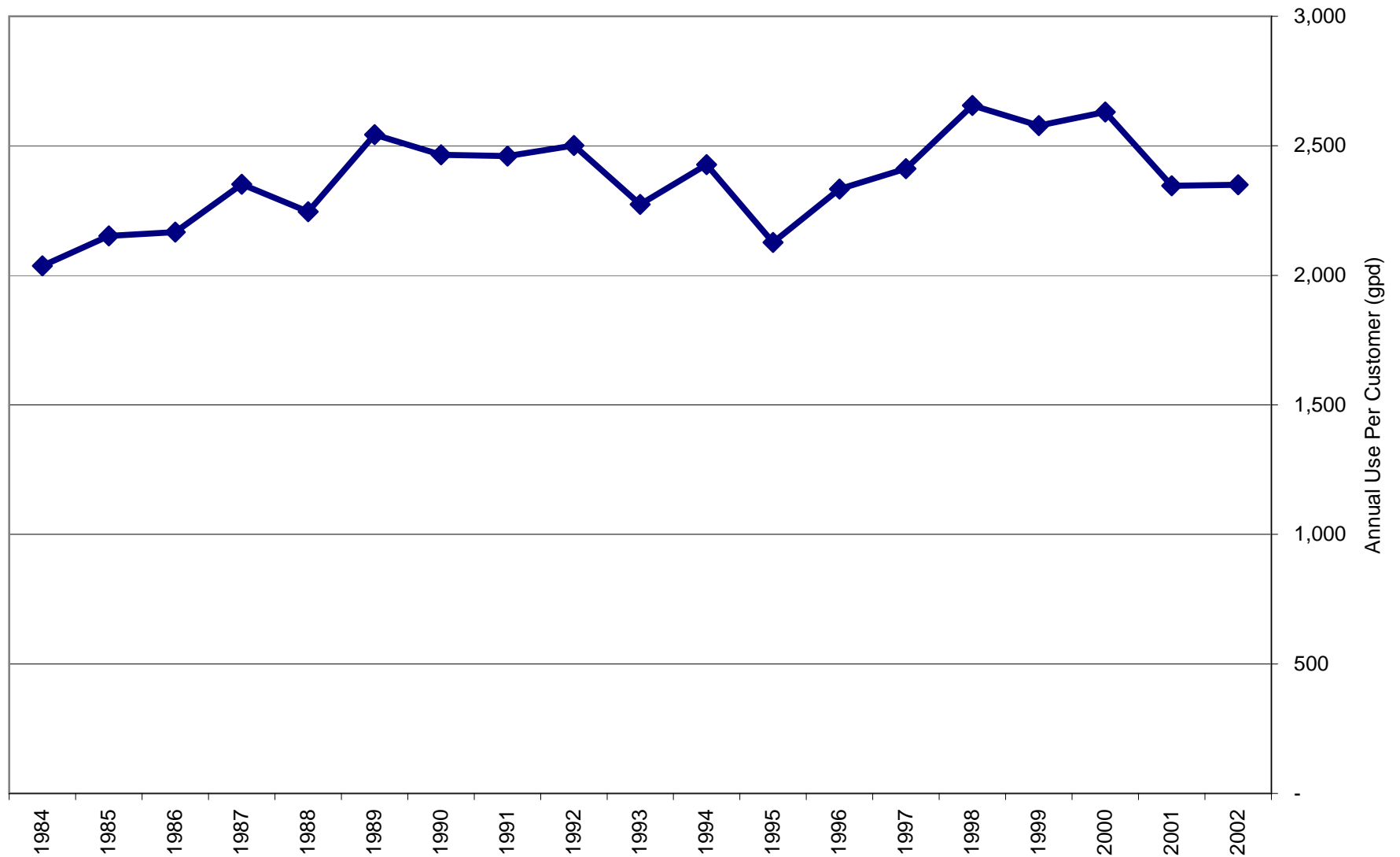
Comparison of commercial/Industrial Flow rates		1992 WWMP Base Flow rate Gal/Gross Ac/Day	Clean Water Services MP 2009	Albany 2011	Philomath 2004	Prince George County 2008	Employment Density per Acre	1992 WWMP Employment Density per Acre	Springfield Design Standards 2006	Proposed 2016 Master Plan
Land Use Designation	Brief Description									
Low-Density Residential	One-family dwellings with some allowance for other types of dwellings. 1-10 DU/AC	950	1020	75 gal/cap/day	100 gal/per (all catagories)			13	Springfield has a short table of specific facilities and uses a flow rate per person (employment), per seat (restaurants), per bed (nursing homes, etc.).	810
Medium-Density Residential	Medium-density residential use and encourage a variety of dwelling types. 10-28 DU/AC	1970	3392					27		2010
High-Density Residential	High-density residential use and is intended to provide an opportunity for a dense living environment. 20-112 DU/AC	4560	7536					62		4890
Neighborhood Commercial	Generally less than 5 acres, serving day to day needs.	1360	2930	1500	1500	2000		34		1360
Community Commercial	5 acres to 40 acres, include a wide range of purchaser goods and entertainment, office, and service needs for a support population smaller than that of the metropolitan area but larger than that of a neighborhood.	2000				6400	36	50		2000
Major Commercial	Includes a wide range of purchaser goods, educational opportunities, entertainment, offices, travel accommodations, and services that attract people from the entire metropolitan area.	2560					54	64		2560
Commercial/Industrial	Areas that allow a compatible mix of commercial and industrial uses that are largely oriented to automobile traffic. The zone is intended to provide for commercial uses and complimentary processing, assembling, packaging, or repairing of previously manufactured products.						24			2600
General Office	Intended to provide for small- to medium-sized office buildings, often in transitional locations between residential and commercial uses.		2930			7500	40			2345
Campus Industrial	Designed for firms that will help achieve economic diversification objectives and that typically have a large number of employees per acre. Designed to provide sites for large-scale offices that provide a scientific and educational research function or directly serve manufacturing uses or other industrial or commercial enterprises.		2930			2000	21			3040
Light-Medium Industrial	Industries that are often involved in the secondary processing of materials into components, the assembly of components into finished products, transportation, communication and utilities, wholesaling, and warehousing.	3040	2930	1300	2750	2000	13	18		3040
Heavy Industrial	A range of manufacturing uses including those involved in the processing of large volumes of raw materials into refined products and/or industrial uses that have significant external impacts.	1520	5850	6000		4000	8	10		1520
Park, Recreation and Open Space	Areas that will conserve and preserve a variety of parks, recreation areas, and open spaces to maintain livability of the metropolitan area. Provides a balance of active and passive recreation opportunities to meet neighborhood, community, and metropolitan needs. Several facilities are allowed.		0							consult master plan for use intensity
Government and Education	includes university and research		2930		500				10-16 gal/per/day	2680



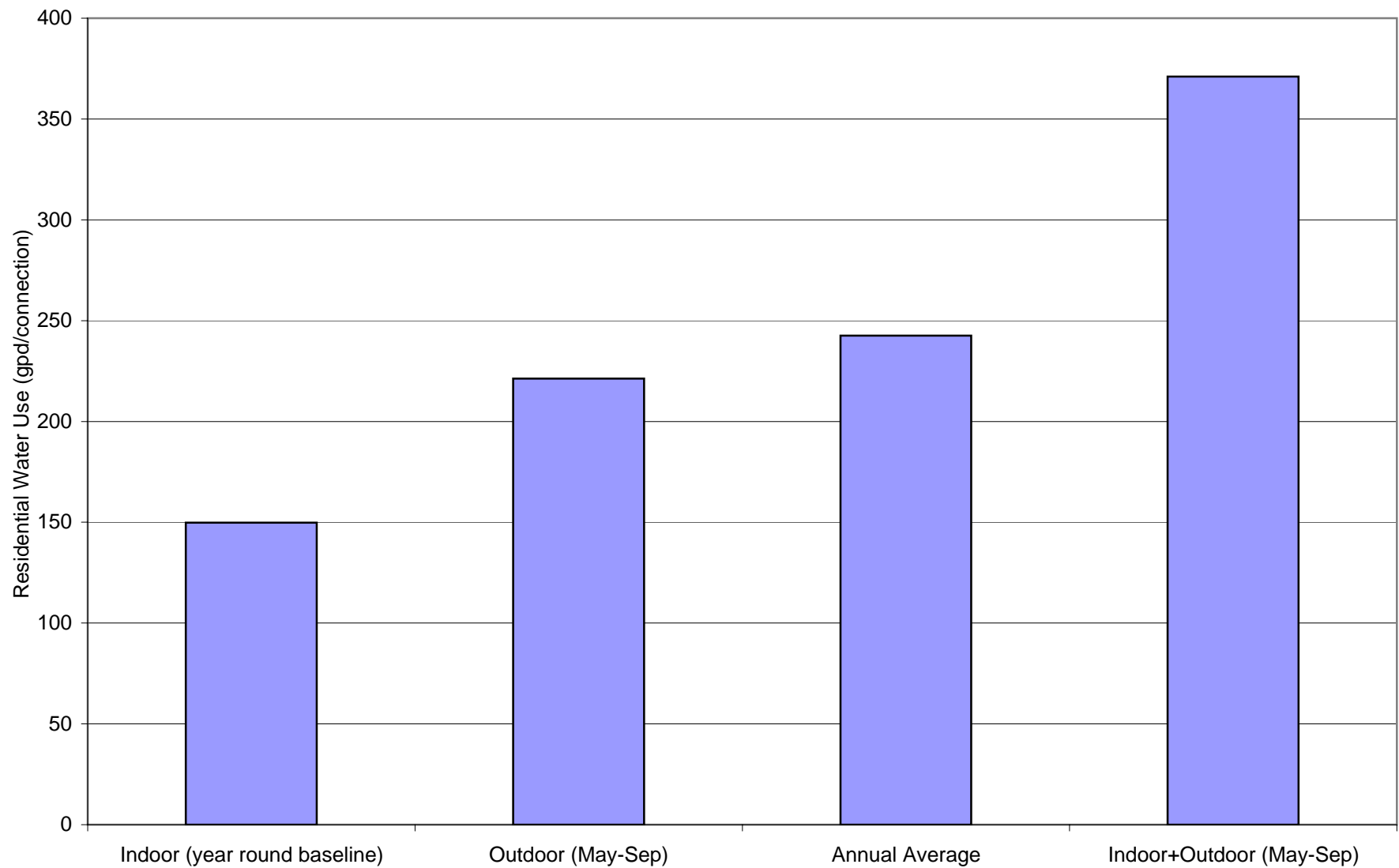
**Large Industrial Users, 2005. Compiled by the WWTP**

<b>Eugene</b>	<b>Avg Process Discharge (gpd)</b>	<b>Acres (Gross)</b>	<b>gal/ac/day</b>		<b>Springfield</b>	<b>Avg Process Discharge (gpd)</b>
ALSCO	80,000	1.15	69,565		Aramark Uniform	13,494
Altech Finishes	7,000	2	3,500		Arclin, USA	12,681
Emerald Forest Products	28,090	10.4	2,701		Farwest Steel Corp.	276
Extreme Technologies dba BowTech-Anodizing	18,264	8.4	2,174		Franz Bakery	11,070
Extreme Technologies dba WaterDog	5,030				International Paper	96,624
Flakeboard America Limited	64,250	15	4,283		Lane County Leachate	79,213
Forrest Paint Company	4,500	3.75	1,200		Lane County Vactor	1,398
Gheen Irrigation Works	31,000	3	10,333		Mac Industries	200
Hynix Semiconductor Manufacturing America	3,500				McKenzie Chrome	1,350
J.H. Baxter & Co.	750				Momentive Specialty Chemical	49,362
MetalWorks Paint and Rust Removal	370				Pacific States Plywood	24,998
Molecular Probes/Life Technologies	4,400	4	1,100		Peace Health Hospital	133,000
Murphy Plywood	1,650				PeaceHealth Annex	2,845
Oregon Ice Cream	62,000	3.2	19,375		Rosboro, LLC	34,095
Pacific Metal Fab.??	1,500	6	250		Sanipac, Inc.	7,480
Peterson Pacific	120				SierraPine/PlyVeneer	12,621
Pierce Fittings	8,910	3.3	2,700		Swanson Group	5,050
Quality Metal Finishing	5,000				Turtle Mountain LLC (Shelley St.)	24,150
Springfield Creamery	39,900	6	6,650		Turtle Mountain LLC (Main St.)	213
Superior Steel Fabrication	4,500				Voith Paper	479
University of Oregon	402,000				Weyerhaeuser Truck Rd.	46,000
Weyerhaeuser NR Company	4,561					
Willamette Valley Company	510					

**Exhibit 19.** Water Use per Commercial/Industrial Connection



**Exhibit 2-19.** Adjusted Residential Water Use by Season (1998-2002)



## SECTION 2

# SYSTEM DESCRIPTION

Eugene Water & Electric Board (EWEB) operates a public community water system serving Eugene, Oregon, and a small number of customers located outside the city limits. EWEB's system has been assigned the state and federal Public Water System Identification No. 41000287. This section provides an overview of the system by describing the customer base, recent water use history, water rights, and the facilities that make up the system.

## Service Area and Population

**Exhibit 2-1** provides an overview map of the EWEB service area, including the EWEB-supplied water companies and districts. The service area is generally bounded by Interstate 5 on the east, the McKenzie and Willamette Rivers on the north, rural areas and farmland on the west, and forested hills on the south.

EWEB's estimated service population for year 2004 is 168,000. This estimate was based on census data and information supplied by the Lane Council of Governments (LCOG). The particular methodology for translating census data to a service population estimate for EWEB is described in the chapter on growth projections.

## Water Use

EWEB's average day demands for the past 20 years have ranged from 22.0 mgd in 1983 to 30.5 mgd in 1998 and again in 2000. The trend over this period for average day demands has been an increase of 0.28 mgd per year.

As typical for Western Oregon utilities, EWEB's demands show a marked increase during the summer months because of outdoor irrigation. During the past 20 years, the summer demands (June through September) averaged 1.8 times the winter demands. The summer to winter multiplier range was 1.4 to 2.1 times. For the period of 1998-2002, summer demands averaged 2.0 times the winter demands.

The highest recorded maximum day demand for the system was 68.8 mgd in 1998. The second highest value of 65.3 mgd was recorded in 2003. The trend over the past 20 years has been an increase at the rate of 0.42 mgd per year.

It is common for maximum day demands to fluctuate more than average day demands. The maximum day demand occurs in the summer because of outdoor irrigation. It is not uncommon for the maximum day demand to drop compared to previous years if the summer is relatively cool and wet. Conversely, it may increase sharply from one year to the next if the summer is relatively hot and dry.

About 50 percent of water use in the EWEB system is by residential customers, with the remaining 50 percent used by commercial and industrial customers.

# Metropolitan Wastewater Management Commission



## Appendix C

*partners in wastewater management*

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### MEMORANDUM

**DATE:** March 6, 2015  
**TO:** Metropolitan Wastewater Management Commission (MWMC)  
**FROM:** Matt Stouder, General Manager  
**SUBJECT:** Analysis of Private Laterals      Agenda Item VII  
**ACTION REQUESTED:** Information and Discussion

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#### **ISSUE**

Contribution of wet weather flows from private laterals in the Eugene/Springfield service area have not been quantified, may potentially be significant, and represent an opportunity to achieve greater control of peak wet weather flows received by the Water Pollution Control Facility (WPCF). Accordingly, the MWMC has expressed an interest in evaluating the role private laterals play to the overall contribution of peak flows at the WPCF, and recently contracted with Peter Ruffier to conduct an analysis and gather information associated with this issue.

#### **BACKGROUND**

During periods of wet weather, the WPCF experiences significant peak flows from infiltration and inflow (I/I) from both the public and private portions of the wastewater systems in Eugene and Springfield. These flows increase collection and treatment costs, reduce treatment efficiency and increase the risk of regulatory non-compliance. Additionally, excessive peak flows contribute to the need for blending (the mixing of primary and secondary treated effluent during critical periods prior to discharge) to protect critical treatment elements.

In recent years, the Cities of Eugene and Springfield have invested heavily in implementing projects aimed at reducing I/I in the public portion of the wastewater system as identified in the 2001 Wet Weather Flow Management Plan (WWFMP), as well as their respective local wastewater master plans. Additionally, the MWMC has made significant investments in wet weather related flow controls, including expanding the capacity of the WPCF to accept and treat peak flows up to 277 MGD.

Recently, the Cities have focused resources to develop Capacity, Management, Operations, and Maintenance (CMOM) plans to serve as an integrated and adaptive approach for management of the local wastewater collection systems. Prior to and



during CMOM discussions, the Commission had expressed an interest in evaluating the role that private laterals play to the overall contribution of peak wet weather flows to the WPCF. In May 2014, the Commission adopted a CMOM framework document which included a private lateral program as one of the ten fundamental elements.

## **DISCUSSION**

In June of 2014, the City of Eugene (on behalf of MWMC) entered into a contract with Peter Ruffier to provide an analysis and options for scoping a private lateral program for the cities of Eugene and Springfield. The scope of work associated with the project included:

- Summarizing the regulatory and policy context and issues pertinent to private laterals.
- Working with key staff to assemble existing information on the source of wet weather flows, and to assess if possible, the significance of I/I from private laterals.
- Performing a survey of peer agency information and data relevant to private lateral metrics.
- Providing an outline identifying next steps for addressing the I/I from private laterals.

Mr. Ruffier's work and findings are summarized in Attachment 1 (Summary Report), and will be discussed at the March 13, 2015, Commission meeting. In general, the Summary Report finds the existing data insufficient to quantify or estimate the contribution of I/I from private laterals into the public system. However, Mr. Ruffier indicated that the private portion of the collection system likely contributes a substantial amount of I/I flow based on anecdotal evidence.

Furthermore, a strategy (detailed in page 9 of 9, Attachment 1) to address I/I from private laterals and further evaluate program requirements includes the following recommended actions:

- 1) Invite select peer agencies to come to Eugene/Springfield to discuss their private lateral programs.
- 2) Establish a common definition of private lateral for the MWMC partners.
- 3) Design and implement pilot project(s) to evaluate the contribution of I/I from private laterals in different parts of the sanitary system.
- 4) Clearly define the functional peak wet weather capacities of the conveyance and treatment units.
- 5) Update the assessment of the effectiveness of rainfall-derived infiltration and inflow (RDII) control and reduction methods.
- 6) Set system-wide objectives and performance measures for further control and reduction of RDII.
- 7) Update the strategic plans and standard operating procedures for flow monitoring of the sanitary sewer system.

- 8) Using the results of steps above, determine whether it is cost-effective to expand I/I control and reduction activities to include some or all of private laterals in the system.
- 9) If the contribution from private laterals is deemed significant and if control and reduction measures are determined to be cost-effective in comparison to measures taken for the public sections of the sanitary system or treatment facilities, develop the policies and procedures necessary to establish a program to address I/I from private laterals and move forward with necessary regulatory and code changes.

### **ACTION REQUESTED**

No action requested; this item is provided for information and discussion.

### **ATTACHMENTS**

1. Summary Report - Analysis and Options for a Private Lateral Program for the MWMC



# **Summary of an Analysis and Options for a Private Lateral Program for the Metropolitan Wastewater Management Commission**

**February 10, 2015**

## **Introduction**

The Eugene/Springfield Regional Water Pollution Control Facility experiences significant peak flows due to rainfall derived infiltration and inflow in the public and private segments of the sanitary sewer system. These peak flows increase the costs to collect and convey water in the sanitary system to the treatment plant, reduce treatment efficiency and increase treatment costs, and increase the potential for overflows and basement backups from the sanitary sewer system. The Metropolitan Wastewater Management Commission (MWMC) and its partners (Eugene, Springfield, and Lane County) have invested considerable resources in assessing, planning, and implementing projects that are intended to reduce the amount of infiltration and inflow to the sanitary system. Significant funding and resources have been applied to the repair and rehabilitation of the public segments of the sanitary sewer infrastructure, and to expanding the capacity of the regional treatment facility to accept and treat peak wet weather flows. The 2001 Wet Weather Flow Management Plan set forth the recommendations that form the foundation of the projects to address infiltration and inflow, including a recommendation to establish a policy related to private laterals and the implementation of a voluntary program to address the repair and rehabilitation of defective private laterals. Although the contribution of infiltration and inflow from private laterals has not been quantified, it is potentially significant and represents an opportunity to achieve greater control over peak flows in the system. As a result, the MWMC has requested an analysis of whether a program to control and reduce infiltration and inflow (I/I) from private laterals in the Eugene/Springfield sewer service area is warranted due to the volume of I/I from these sources and, if so, development of an outline of options for the fundamental elements of such a program.

## **Background**

The analysis is predicated upon the following factors:

*State and Federal regulations prohibit sanitary sewer overflows (SSOs) and require management of wet weather flows.*

- The regulatory environment under the federal Clean Water Act and the State of Oregon's implementation of the National Pollutant Discharge Eliminations System (NPDES) permit program establish strict responsibilities and liabilities for the management of sanitary sewer systems and wet weather flows received by, and transported in, these systems. The U.S. Environmental Protection Agency (EPA) has set a strict prohibition on overflows from the sanitary sewer system, and the State of Oregon has established definitive parameters for the control and management of peak wet weather flows. These regulations and the NPDES permit issued to the MWMC have resulted in significant capital expenditures for upgrading the public sanitary sewer collection system and for the construction of peak wet weather treatment units at the regional wastewater treatment plant.



*The MWMC has invested significantly in the control of wet weather flows, but these investments have not yet addressed I/I from private laterals.*

- Wet weather flows, generated from infiltration and inflow (I/I) to the sanitary sewer collection system, contribute to peak flows, the associated risk of sanitary sewer overflows, and to the significant operating and maintenance costs necessary to transport to, and treat such flows at, the Eugene/Springfield Regional Water Pollution Control Facility. Eugene and Springfield are investing substantial resources in the maintenance of the public wastewater system to minimize and control I/I. The locally implemented sewer maintenance program is effective at sustaining the physical integrity of the public system and addressing areas of the system that have high rates of I/I, however there has not been a direct assessment of its cost effectiveness in further I/I reduction. The capital program continues to find high priority repairs as part of the wastewater rehabilitation program and Eugene is developing the assessment process in conjunction with the master plan update and completion of its wastewater model. However, data indicates that this program as currently configured will not control peak wet weather flows to a level that will preserve the planned functional life span of the peak wet weather facilities of the regional treatment plant. The ability of the program to manage the risks of wet weather overflows to meet anticipated regulatory standards is also unknown. The amount of I/I contributed from private laterals in the system is currently unquantified but may be significant, based upon assessments from other wastewater agencies and the best professional judgment of local staff.

*The MWMC has the authority to set standards for the performance of private laterals.*

- The MWMC has expressed an interest in evaluating the role of private sanitary sewer laterals to the contribution of peak wet weather flows, and addressing this contribution if found to be significant. The MWMC has the authority under its enabling intergovernmental agreement to set standards for the sanitary sewer system serving the Eugene/Springfield Regional Water Pollution Control Facility. The cities of Eugene and Springfield have the responsibility to implement such standards in their respective jurisdictions.

The objectives for the analysis of an I/I reduction program for private sewer laterals were to assess, using local data to the extent possible, the significance of I/I from private laterals to the peak flows observed in the sanitary sewer collection system and at the regional wastewater treatment plant. Based upon this assessment, a determination would be made about whether the reduction and control of I/I from private laterals can further the objectives of the work that Eugene and Springfield are performing under the capacity, management, operations, and maintenance program; if such reduction and control would help preserve the planned functional life of the existing peak wet weather treatment facilities; and whether a private lateral program would be important to achieve anticipated regulatory standards for wet weather flow management. If a positive determination is made about these outcomes of a private lateral program, an outline would be developed of the options for a program that would serve MWMC through implementation in Eugene and Springfield.

## **Summary of Findings**

### *Regulatory Considerations and Context*

Within the regulatory context, wet weather flows are addressed primarily from an objective of reducing the risk of overflows from sanitary sewer systems and to prevent the need to bypass treatment units within wastewater treatment facilities. For the past number of years the U.S. EPA has adopted a national focus on addressing SSOs within its enforcement program, and has driven the development and incorporation of implementation programs related to the effective operation and maintenance of sanitary sewer systems in



NPDES wastewater discharge permits. Existing State regulations under the Water Quality Regulations of Division 41, section 340-041-0120, set forth specific parameters related to wet weather related SSOs which establish seasonal storm event exceptions to the SSO prohibition. EPA has not approved these exceptions. Consequently, the State of Oregon has publicly stated that its position will be consistent with the EPA's strict policy on the prohibition of SSOs regardless of the State regulations, and this is reflected in the language in the NPDES permit held by the MWMC.

The lack of explicit rules and guidance for enforcement of wet weather caused SSOs leaves Oregon NPDES permittees (including the MWMC) at some level of vulnerability in determining their legal liabilities from third party enforcement actions. It is clear that having a robust program for management of the sanitary sewer system and I/I related wet weather impacts, with monitoring data to document effective implementation, is a strong element for demonstrating an affirmative defense to any challenge of noncompliance.

Several other elements of the Clean Water Act and the NPDES program are pertinent to the consideration of a program to control and reduce I/I from private laterals. Federal regulations under the Clean Water Act have been interpreted by the U.S. EPA to require that all treatment units of a wastewater treatment facility be used in the collection, transport, and treatment of sewage wastes. Accordingly, bypassing any treatment unit is prohibited. This prohibition is reflected in the General Conditions of the NPDES permit issued to the MWMC (Schedule F, Section B, paragraph 3). However, many treatment facilities have been designed and are operated to protect treatment units from washout by peak wet weather flows by intentionally diverting some portion of the waste stream around treatment units and then "blending" the internal flows prior to disinfection and discharge. This practice protects the long-term treatment capability of the wastewater treatment facility and still results in a treated, disinfected effluent that complies with the water quality standards assigned in the NPDES permit. High peak flows generated during wet weather events are the primary driver for utilizing blending, any program that helps to reduce these peak flows will contribute to a reduction of the frequency and magnitude of a blending event.

MWMC's NPDES permit also contains a performance requirement that is influenced by wet weather derived I/I, that being a required minimum of 85% percent removal for both the 5-day Carbonaceous Biological Oxygen Demand (CBOD<sub>5</sub>) and Total Suspended Solids (TSS). During peak flows, the concentration of pollutants in the influent waste stream are reduced by the proportion of I/I in the wastewater, which decreases the efficiency of treatment and makes it difficult to meet the 85% removal minimum. Again, any program that reduces the volume of I/I will reduce the difficulty of meeting the 85% removal requirement.

Projections about future regulations related to the management and effects of wet weather flows, and what may be included in future NPDES permits related to wet weather/peak flow controls, SSO prohibition language, sanitary sewer program requirements, and blending allowances is highly speculative. What can be projected with some certainty is that the focus on SSOs, uncertainty about the regulatory status of blending, the requirements for programs to effectively manage sanitary sewer systems, and the implications of performance requirements will all continue to be in play and will likely depend upon individual negotiations for renewal of any permit. Correspondingly the questions of interpretation of NPDES rules and regulations and the risks associated with a challenge of noncompliance will continue to be of concern to permittees.



### *Wet weather/peak flow issues for MWMC*

The MWMC was established in 1977 through an inter-governmental agreement between Lane County and the Cities of Eugene and Springfield, to construct and operate the regional wastewater facilities serving the Eugene-Springfield area. The intergovernmental agreement (IGA) details the purpose of the Commission, and the specific roles and responsibilities of each of the signature parties. The IGA also specifies that the MWMC has the responsibility to comply with state and federal regulations, including those described above relating to wet weather flow impacts and performance standards. With respect to the subject of wet weather flows and I/I, the IGA specifically assigns to the MWMC the function of setting minimum standards for the construction and maintenance of all parts of the sanitary sewer system serving the Eugene/Springfield Regional Water Pollution Control Facility. The cities of Eugene and Springfield have the related responsibility to implement such minimum standards in their respective jurisdictions, as accorded by the IGA. Such standards presumably may include considerations of managing the infiltration and inflow contributing to peak wet weather flows in the overall wastewater system necessary to comply with the pertinent regulations and reduce the risks of noncompliance.

Over the years the MWMC has devoted considerable time and attention to the issue of peak wet weather flows. In 2001 the Commission adopted the Wet Weather Flow Management Plan (WWFMP), which had as an overall objective to determine the most cost-effective and politically feasible set of solutions for managing excessive wet-weather wastewater flow rates both in the collection system and at the water pollution control facility. During development of the WWFMP, program elements related to addressing the I/I from private laterals were considered by a Citizen's Advisory Committee (CAC), which rendered the following key decision:

*Implementation of a voluntary, private lateral replacement program: This was considered to be an essential component of the WWFMP. Even though a solution was identified where only the public portion of the system requires rehabilitation, the private portion contributes a significant portion of the I/I and therefore must be addressed.*

The CAC recommended that this key decision be formulated into a Policy Statement and included as a formal part of the WWFMP. This recommendation received support in public comments received during the WWFMP process, but has never been implemented. Furthermore, during its assessment of the various alternatives for managing peak wet weather flows the CAC also evaluated the requirements for implementing the Plan's recommendations, and listed potential options for developing a voluntary private lateral rehabilitation program to be performed in conjunction with the implementation of the WWFMP as well as policy considerations for implementation of such a program.

The current programs and activities being implemented by the city partners in MWMC are detailed in annual reports submitted to the DEQ, as required by the NPDES permit (Schedule B, Special Condition 3a). These reports summarize the inspection, maintenance, repair, and rehabilitation activities undertaken in the public sewer system. For example, in 2013-2014 the City of Springfield's I/I program activities included closed circuit TV inspection, manhole inspection, manhole and pipeline repair, internal pipe patching, riser repairs, pipeline cleaning, pipeline root removal, flow and rain gauge monitoring and map and database updating. The City of Eugene undertakes similar activities for the management of I/I.

Both Cities implement Section 714.2 of the Oregon State Plumbing Code (2011), which states that "No rain, surface, or subsurface water shall be connected to, or discharged into, any drainage system unless



first approved by the Authority Having Jurisdiction.”<sup>1</sup> The Cities require the correction of improper connections from private properties to the public sanitary sewer system when such are observed during smoke testing or by other means of identification, using the authority of local sewer use ordinances (in Eugene, the prohibition to connecting stormwater drains to the sewer system is contained in City Code 6.610). However, this language would require modification to require rehabilitation of private sewer laterals. Eugene does have a voluntary private lateral program that educates home owners about the benefits to maintain private laterals. Eugene encourages home owners to consider repair of their private laterals when the public system will be worked on. Private laterals that serve multiple properties are being replaced with public systems and individual property connection points. Eugene has acquired the ability to inspect private laterals with a main-launched TV camera and are investigating private lateral lining by both public contract and city crew efforts.

Other activities to reduce and manage I/I are largely restricted to work on the public sewer system, with the exception being the historical use of smoke testing used to identify gaps, voids, and defective pipe segments in the sanitary sewer system. Neither City has specific code requirements at this time related to the proper operation and maintenance of private sewer laterals connected to the public sanitary system, and this lack of authority inhibits the Cities’ ability to take more formal or aggressive corrective actions to control and reduce the contribution of wet weather derived I/I from private laterals.

#### *Potential Significance of I/I from Private Laterals*

The WWFMP and subsequent updates through the 2004 MWMC Facilities Plan and the 2014 Facilities Plan Update all documented the significance of rainfall derived infiltration and inflow (RDII) to the large peak flows experienced at the wastewater treatment facility. Flow monitoring programs conducted by MWMC and its partners do not specifically target the quantification of rainfall induced I/I from private laterals, so it is very difficult at the present time to accurately identify how much of the peak flows seen in the system is coming from private laterals and connections. It may be postulated however, that given the substantial efforts already undertaken by MWMC and its partners to rehabilitate the public sewer system and the continuing large peak flows generated in the system that private laterals are likely to have a meaningful volumetric contribution to wet weather flows.

Both Springfield and Eugene have, over time, conducted significant monitoring of flows in their respective sections of the sanitary sewer system. This information is maintained in various databases, and is generally accessible for query and analysis. The information has been used to develop and test hydraulic models of the sanitary system, which have in turn been used as inputs to the design of peak wet weather conveyance and treatment units at the regional wastewater treatment plant. There is no specific monitoring of flows from private laterals in either community. Both cities are now coding defects and visible infiltration and inflow from private laterals during CCTV inspections and including this information in their inspection and maintenance databases.

There appears to be only one report on an assessment of the monitoring data relative to the effectiveness of I/I reduction efforts, “*A study of the Effectiveness of Wastewater Collection Rehabilitation to Reduce Infiltration and Inflow*” that was completed in 2004 for the City of Eugene. This analysis reviewed the existing wastewater rehabilitation program and concluded that the project methodology applied was successful, in most cases equaling or exceeding the Wet Weather Flow Management Program’s rainfall derived infiltration and infiltration reduction rates without rehabilitating private laterals. There has been

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<sup>1</sup> However, this code applies to new, remodels, additions or repairs; it is not a mechanism to require rehabilitation.



no update of this report. Springfield has not conducted a similar analysis. There has been no regional assessment of the effectiveness of I/I reduction activities, although there have been some updates of hydraulic models used in the planning of capital projects related to wet weather flows and peak capacities of treatment units.

Specifically in regards to private laterals, the City of Eugene Public Works Maintenance Division prepared a “*Wastewater Service Laterals Report*” in 2010 which attempted to document the size of the private lateral system in Eugene and estimate the I/I flow contributions from private laterals to the overall flows in the system. The analysis used data from both Eugene’s maintenance management system and the GIS system, and generated a best guess estimate of the size of the total service lateral system at approximately 625 miles, including about 43,000 service connections and lower lateral line and 59,000 services on private property or upper laterals. Applying these numbers to observed and estimated I/I rates from main line CCTV assessment data for private laterals, the report estimated an average aggregate daily flow rate of 885 GPM, or 1.27 mgd<sup>2</sup>, from private laterals (these estimates were conservative and may likely be low, given field observations in the Eugene/Springfield sewer system). The report calculates an annual cost to convey and treat this flow as \$300,000. The report also conducted a literature review of information related to private laterals, and summarized that “...*I/I contribution rates from the service lateral system vary widely, but generally fall between the range 30–70%.*” Springfield has not conducted a similar assessment of private laterals, and at this time has not collated information relative to the number of private laterals or scale of the private lateral system in their wastewater service area.

The flow monitoring programs for both cities is currently in a state of change. Springfield is re-evaluating its monitoring locations and developing a strategic plan for future monitoring. Eugene is revamping its sanitary sewer collection system model. Flow monitoring equipment for both communities needs to be updated in general. Neither community has a summary document or report on the flow monitoring program procedures or objectives. The flow monitoring programs for the two communities are not closely coordinated, for methodology or objectives. Other than in the Wet Weather Flow Management Plan, there are no clearly stated objectives or performance measures for I/I reduction programs. Perspectives on the objectives appear to have changed over the years as the personnel involved in the program have changed, and resources and priorities have changed as budget availability and maintenance needs have evolved.

Based upon the existing flow monitoring data and wastewater system maintenance records, it is not possible to render a definitive quantitative conclusion about the significance of non-sanitary flows from private laterals to the overall peak wet weather flows transported to the regional wastewater treatment facility. However, peer agency information, visual observations from local CCTV inspections, and the best professional judgment of local wastewater staff leads to a subjective conclusion that private laterals may be contributing substantial I/I flows and that this warrants more formal attention and evaluation.

#### *Summary of Private Lateral Programs in Oregon*

A survey was conducted of peer wastewater agencies in Oregon to assess the existence of programs to control and reduce I/I from private laterals and learn from any experience gained in the development and implementation of such programs. The survey found that several municipalities in Oregon have

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<sup>2</sup> The report notes “The reader is cautioned these are rough estimations due to the incompleteness of the data sources and the level of interpretation, but does provide useful insights based on observed findings.”



developed and implemented private lateral programs. These programs can provide some insights into the different conditions, practices, regulations, and policies that can be included in a private lateral program.

All of the programs were motivated by an objective of reducing the contribution of non-sewage flows from private laterals to the overall I/I in the sanitary system (St. Helens and McMinnville estimated that up to 50% of I/I in their systems originated from private laterals). All of the programs are driven by an awareness of the regulatory liability associated with sanitary sewer overflows, the potential health hazards posed by defective sewer laterals, and the increased costs of handling non-sewage water.

In each of the case examples, the municipality defines what a private sewer lateral is and sets clear expectations (in municipal code) for the responsibilities of the private property owners to maintain their sewer laterals in proper operating condition and to repair said laterals if they are determined to be defective. These code requirements serve as the foundation for the private lateral programs, establishing the relevant responsibilities and granting the municipalities the authority to inspect or monitor private laterals and require repairs if the need is so determined. Even in communities that do not have a formal program to address private sewer laterals, there is usually code language relating to the authorities of the service provider and the responsibilities of the private property owners in respect to private sanitary sewer service connections.

Each of the private lateral programs establishes some mechanism to determine the condition of a private lateral (such as with smoke testing, inspection during main line repair or rehab projects, or from other inspections or observations), sets forth the procedures for a private property owner to conduct the appropriate necessary repairs, clarifies timing and the responsibility for funding of the work, and includes some level of penalties or enforcement (which may include monetary penalties or denial of service).

Assessment of the effectiveness of the private lateral programs in Oregon has been largely subjective, due to the challenges of conducting accurate pre- and post- monitoring of flows. For the City of St. Helens, which instituted its private lateral program in response to regulatory mandates related to wet weather flows, there have been no recent wet weather associated overflows, peaking factors have been reduced in the wastewater system, pump station operating times have decreased, and there have been fewer operational call-outs for pump station events. The other communities do not report quantitative results from their programs.

The issues of wet weather, I/I, high flow peaking factors, sanitary sewer overflows, and related concerns over private laterals is not unique to Oregon. Numerous studies have demonstrated that private laterals can be a significant source of I/I in sanitary sewer systems. Many other communities in the United States have developed programs to address these issues, and a significant amount of study has been undertaken by the professional organizations associated with the technology and management of wastewater services. Examples of code language related to private sanitary sewers is presented in papers of the proceedings of the annual Water Environment Federation's Technical Conference and in the database of the Private Property Virtual Library (hosted by the Water Environment Federation).

In addition to the basic program elements described for the private lateral programs in Oregon other cities have developed alternate strategies and requirements, such as: compliance documentation to demonstrate that a private sewer lateral is free of leaks (East Bay Municipal Utility District (EBMUD), CA and Greencastle, IN); requirements that inspection and testing of sewer laterals be done at the time of remodel or sale of an existing building (City of Sausalito, EBMUD, Rock River Water Reclamation District, IL,



West County Wastewater District, CA, Wickliffe, OH), and requirements for the distribution of private side-sewer educational flyers at the time of sale, major building remodel or additions to properties in order to educate property owners on the conditions of private side-sewers (City of Tacoma).

### *Policy considerations*

The potential elements and related supporting policies for implementation of a private lateral program were outlined as part of the development of the WWFMP in 2000. The fundamental policy issues involved with establishing a private lateral program include:

- Is the program voluntary or mandatory?
- Who must participate?
- Who pays for repairs and rehabilitation?
- How (and when) is the program implemented?
- What local code revisions or additions are necessary to support the program?
- How is equity of program requirements addressed across the MWMC partners?
- How is the program addressed within the regulatory system applied to MWMC?

Some of these policy considerations are self-explanatory and have received some debate at the administrative, management, and operational levels within the MWMC program. One of the more significant issues—that of how a private lateral program would be addressed within the regulatory system—has not received as much discussion. Under current Clean Water Act regulations and State implementation activities, a private lateral program would be a discretionary activity by a permittee. Such a program could be developed and implemented solely at the discretion of the individual entity as a means to reduce peak wet weather flows and reduce risks of noncompliance with regulatory requirements (such as the prohibitions on SSOs), but not be explicitly included in a NPDES permit thereby giving the entity maximum flexibility in program implementation and modification. As an alternative, the entity could seek to have the elements of the private lateral program incorporated into a general sanitary sewer program for inclusion in the NPDES permit. This approach would give the private lateral program official regulatory “sanction,” would establish an explicit basis (and public justification) for allocating resources to the effort, and would motivate performance measurement and reporting. A permit requirement for a private lateral program would also establish a basis for reporting and a risk of noncompliance with the stated program-required elements (albeit with the possibility of an affirmative defense against a permit violation), and would restrict the flexibility of the permittee to quickly modify the program as conditions may warrant.

### **Options for Addressing the Infiltration and Inflow from Private Sewer Laterals**

The findings summarized above can be distilled into the following conclusions:

- Regulatory standards exist for the management of wet weather flows and the prohibition of sanitary sewer overflows,
- Substantial penalties are associated with noncompliance with the regulatory standards,
- The MWMC has the responsibility under the intergovernmental agreement (IGA) to comply with state and federal regulations,
- The Eugene/Springfield Regional Water Pollution Control Facility experiences significant peak flows due to infiltration and inflow in the public and private segments of the sanitary sewer



system. These peak flows increase the costs to collect and convey water in the sanitary system to the treatment plant, reduce treatment efficiency and increase treatment costs, and increase the potential for overflows from the sanitary sewer system,

- Significant funding and resources have been applied by MWMC and Eugene and Springfield to the repair and rehabilitation of the public segments of the sanitary sewer infrastructure, and to expanding the capacity of the regional treatment facility to accept and treat peak wet weather flows,
- The MWMC has the authority under the IGA for setting minimum standards for the construction and maintenance of all parts of the sanitary sewer system serving the Eugene/Springfield Regional Water Pollution Control Facility. The cities of Eugene and Springfield have the related responsibility to implement such minimum standards in their respective jurisdictions,
- Neither City has specific code requirements at this time related to the responsibilities for proper operation and maintenance of private sewer laterals connected to the public sanitary system,
- There is currently insufficient data to quantitatively document the contribution of I/I from private laterals to the local or MWMC wastewater system,
- There is anecdotal evidence from Eugene and Springfield, and quantitative data from peer agencies, of the potential significance of these contributions,
- Eugene and Springfield have the capability to conduct flow monitoring of the sanitary sewer systems within their jurisdiction,
- There are case examples of, and practical experience with, private lateral programs of peer agencies that can be used for reference and guidance.

Working from these conclusions, a strategy and list of possible actions to further evaluate the need for, and characteristics of, a program to address I/I from private sewer laterals can be formulated, as follows:

1. Invite select peer agencies to come to Eugene/Springfield to discuss their private lateral programs, or work with the Oregon Association of Clean Water Agencies to conduct a workshop on effective programs for the control of I/I from private laterals, as an educational opportunity to learn from the experience of other agencies.
2. Establish a common definition of private lateral for the MWMC partners, which should include a distinction between private laterals within the public right of way, and private laterals on private property.
3. Design and implement pilot project(s) to evaluate the contribution of I/I from private laterals in different parts of the sanitary system. Focus the pilot projects on areas where the private sections of the system are known or suspected to be significant contributors of I/I flows, and conduct repair and rehabilitation measures to control and reduce the I/I and perform a pre- and post-analysis of the effectiveness of the measures.
4. Clearly define the functional peak wet weather capacities of the conveyance and treatment units, and their anticipated service lives based upon the original design parameters. Conduct an analysis of the risk of SSOs and blending using historical data on peak flows.
5. Update the assessment of the effectiveness of rainfall-derived infiltration and inflow (RDII) control and reduction methods using existing data from both Eugene and Springfield.
6. Set system-wide objectives and performance measures for further control and reduction of RDII.
7. Update the strategic plans and standard operating procedures for flow monitoring of the sanitary sewer system, consistent with the objectives and performance measures in step 6.



8. Using the results of steps above, determine whether it is cost-effective to expand I/I control and reduction activities to include some or all of private laterals in the system (i.e. whether to address laterals only to the right-of-way or all the way to the building).
9. Decision point: If the contribution from private laterals is deemed significant and if control and reduction measures are determined to be cost-effective in comparison to measures taken for the public sections of the sanitary system or treatment facilities, develop the policies and procedures necessary to establish a program to address I/I from private laterals and move forward with necessary regulatory and code changes:
  - a. Develop and incorporate language in local sewer codes adopting the common definition of private lateral, setting standards for the proper operation and maintenance of private laterals connected to the public sanitary system, and giving the cities the authority to inspect and enforce these standards.
  - b. Develop the policies and processes necessary to establish an ongoing program to address I/I from private laterals.